FOUNDRY TRADE JOURNAL
Established 1902
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 86 Thursday, March 31, 1949 No. 1700

49, Wellington Street, London, W.C.2
'Grams: "Zacatecas, Rand, London"
'Phone: Temple Bar 3951 (Private Branch Exchange)
PUBLISHED WEEKLY: 26s. per annum (Home and Overseas)

Production Efficiency

Efficiency in manufacturing processes being the keynote of the Anglo-American Productivity Council, various bodies and individuals have spent time and energy devising formulæ for the measurement of this attribute. There are too many variables to make this possible and what may seem to be obviously correct actions to take to ensure efficiency, may have an adverse effect on the arithmetical ascertainment. Thus a firm installing really high-grade washing and bathing facilities for the staff is undoubtedly making a worthwhile contribution to efficiency in the military sense, but, as assessed by the accountant, the firm is apparently operating less profitably—the normal efficiency factor being profit—to the extent of the annual depreciation and maintenance charges. It is impossible accurately to measure efficiency, but as tidiness is a *sine qua non* of efficient management, it can generally be taken as a reliable index. A grand tour of the French metallurgical industry having been completed, together with a foundry owner we discussed the relative efficiency of the firms visited. Then we each prepared a list in descending order of efficiency and compared the result with the financial position as disclosed by the "Echo de la Bourse." Strangely enough, everything tallied and there was a confession by us both that tidiness had been the sole basis for judgment. Yet there was a mixture of the old and modern amongst the plants visited.

A factor in over-all efficiency, which is never obvious, is the order book and its control. In a foundry there are usually divisions designed to take care of heavy and light work, or machine- and hand-moulded varieties, and the load to be placed on each must be even and continuous. The modern foundry sales manager provides himself with a "loading chart," which tells him exactly how many weeks' work he has handed over to production side in each section and additionally what promises of delivery he can give to his customers. For the smaller concerns, instead of sections, the foundry owner can work on the loading up of his men, singly or in small groups, as he can, on the receipt of an order, decide whom, amongst his staff, is best suited to undertake its production. The mental effort of making such a chart will be a check on the price quoted. Obviously, this will be a very rough and ready study, but it is still worth while.

Loading studies indicate when there is the need for orders of a certain type, and it is on their acquisition that a high level of production will depend. This demands salesmanship of a high order, for not only is it necessary to know the requirements of the foundry, but the potential source of such orders. Ever since the war finished, the demand for most types of castings has been greater than the supply, but statistics tend to show that conditions are changing. Thus, it seems to us essential that, for at least the jobbing foundries, a suitable man or men should now be undergoing a rapid training for ensuring that even load on the foundry, which is so necessary for efficient production. Castings are not easy commodities to sell, unless resort is had to price cutting—a dangerous proceeding unless it be based on true knowledge of costs. Efficiency will not be obtained by undertaking the whole of one customer's work at an over-all price. One reasonably astute foundry manager, believing the work to be of a straightforward character, accepted such an arrangement, only to find that the first order he received was for a baseplate carrying about fifty cores!

Contents

Production Efficiency, 277.—Sand-testing Reports, 278.—Death of D. Paxman, 278.—Forthcoming Events, 278.—"Men Only" Dinner, 278.—Some Reflections on the Investment Casting Process, 279.—A Decade of Progress in British Ironfounding, 283.—Book Review, 288.—B.I.S.R.A. Exhibits at Imperial College, 288.—The Addition of Oxygen to the Cupola Blast, 289.—Death of Mr. A. E. Chell, 290.—The Development of Inventions, 291.—Notes from the Branches, 291.—Exhibitions for Training Purposes, 292.—Mond Nickel Fellowship Committee, 292.—The "Garrett" Report, 292.—News in Brief, 293.

Sand-testing Reports

Two interim reports of the Joint Committee on Sand Testing* are now available on loan to members of the Institute of British Foundrymen, on writing to Manchester. They are:—

Report J.S.C. 101

The Determination of Specific Surface and Coefficient of Angularity of Sands, by T. R. Walker; and

Report J.S.C. 102

Grading of Sands by the Water-settling Method, by R. W. Ruddle (British Non-Ferrous Metals Research Association).

The first Report gives an apparatus and formula for calculating the specific surface of a sand (or other fine powder) by a modified permeability test. It is based on the assumption that each fraction of a material separated by sieving consists of uniform spherical grains with a diameter equal to the average of the two sieves used for separating it. Detailed description and method of use are quoted for the apparatus and its calibration. Finally, a method is given for the determination of the Coefficient of Angularity of a sand by dividing the actual specific surface (calculated from the results given by the apparatus), by the theoretical specific surface, the latter being obtained by calculation from the sieve fractions.

The second report, J.S.C. 102, describes an apparatus and method for determining the grading of a sand by the separation of particles settling through a column of water and dividing the collected particles at timed intervals. It is found necessary to use calibration factors for each group of sand so tested, and, in the case of other than pure silica sands, to de-flocculate the material by pre-treatment with alkali. A full determination may be carried out in about 1-1½ hours and a routine test in a shorter period. Previous separation of clay is unnecessary and advantage is claimed because small particles do not adhere to larger ones to cause misleading figures; this latter being a source of error in dry-sieving tests. At the conclusion of this report typical figures are quoted for sands from several well-known groups.

*The Joint Committee on Sand Testing comprises representatives from the Institute of British Foundrymen, the Iron and Steel Institute, the British Cast Iron Research Association, and the British Non-Ferrous Metals Research Association.

"Men Only" Dinner

Last Friday, at the Criterion Restaurant, Piccadilly, the London branch of the Institute of British Foundrymen held their second social function of the season. This took the form of a dinner and cabaret show for members and their male guests. A company of over 100 were assembled; the loyal toast and that of the London branch were proposed by the President, Mr. P. D. Pincott, and the rest of the evening was devoted to informal conversation, broken by two intervals for light entertainment by the cabaret artists. At the conclusion, this resumption of a function which was previously the annual social feature of the Branch, was deemed to be an unqualified success.

Forthcoming Events

APRIL 4.

Institute of British Foundrymen.

Sheffield Branch:—"The Feeding of Steel Castings," by B. Gray, followed by the Annual Meeting at the Royal Victoria Hotel, Sheffield, at 7.30 p.m.

APRIL 5.

Institution of Production Engineers.

Birmingham Section:—Day visit to the Austin Motor Company, Limited, at Longbridge, Birmingham.

The Institute of British Foundrymen.

Birmingham Students' Section:—Annual General Meeting and Short Paper competition, at the Chamber of Commerce, Birmingham, at 7.15 p.m.

Institution of Works Managers

Leeds Branch:—"Industrial Safety," by H. G. Wimbolt, at the Great Northern Station Hotel, Leeds, at 7 p.m.

APRIL 7.

Institute of Vitreous Enamellers

Midland Section:—Annual General Meeting, followed by "Inspection, Testing and Defects," by Mr. Laithwaite, at the Chamber of Commerce, New Street, Birmingham, at 7.15 p.m.

The Institute of Metals.

London Local Section:—Annual General Meeting, at 6 p.m., followed by open Discussion on "Controlled Atmospheres," at 4, Grosvenor Gardens, London, S.W.1.

Birmingham Local Section:—Annual General Meeting, at 6.30 p.m., at the James Watt Memorial Institute, Great Charles Street, Birmingham.

APRIL 8.

Institution of Production Engineers

Eastern Section:—"Practical Approach of Research to Industry," by H. W. Hobbs, at the Lecture Hall, Electric House, Ipswich, at 7.15 p.m.

Institute of British Foundrymen

East Midlands Branch:—Annual Dinner and Dance, at the Bull Hotel, Leicester.

APRIL 9.

Newcastle-upon-Tyne Branch:—Annual General Meeting, followed by an open Discussion, at the Neville Hall, Newcastle-upon-Tyne, at 6 p.m.

Lancashire Branch:—Annual General Meeting, followed by "Contact Welding and Welding of High Tensile Steel," by Dr. Hill, at the Engineers' Club, Albert Square, Manchester, at 3 p.m.

Bristol and West of England Branch:—Annual General Meeting, followed by a Dinner and light entertainment, at the Grand Hotel, Broad Street, Bristol, at 3 p.m.

Institution of Production Engineers.

Yorkshire Graduate Section:—Visit to works of W. & T. Avery, Limited, Sherburn-in-Elmet, near Leeds, at 2.15 p.m.

Death of Mr. E. P. Paxman

It is with very deep regret that we record the death of Mr. E. P. Paxman, Managing Director of Davey, Paxman & Company, Limited, who died very suddenly on March 25, 1949, at the early age of 47 years.

Mr. Paxman, who was born in 1901, was the son of the late Mr. James N. Paxman, founder of the above firm. He was educated at Oundle School, and thence went to Cambridge University, where he obtained a first class honours degree in mechanical engineering. He had a period of training with Metropolitan Vickers Electrical Company, Limited, and then entered the employ of Blackstone & Company, Limited, Stamford. He joined Davey, Paxman & Company, Limited, in 1926, and shortly afterwards became Chief Engineer. After acting as Director and then joint Managing Director, he became Managing Director on the association of the company with Ruston & Hornsby, Limited, of which company he also became a Director.

Some Reflections on the Investment Casting Process*

Limiting Factors in Present-day Practice

By D. F. B. Tedds

A number of years have now elapsed since investment casting was introduced into this country from America. During that period, certain arguments and controversies have been brought forward, advocating various methods for carrying the process through. This Paper sets out a few of the points at issue and makes an effort to clarify and summarise the position to date.

General Outline of Process

The general procedure of this process is well known and must be familiar to all, but the various controversial stages of the process may be summarised as shown in Chart I.

At each stage of the process there are at least two alternatives, and it is proposed to discuss each point in turn.

Dies, into which the dispensable pattern materials are injected, affect the quality, delivery speeds and the cost of the castings. Intricacy and accuracy both start with the making of these dies. The patterns cannot be more accurate than the dies and the castings cannot be more accurate than the patterns.

The two main methods of producing such dies are (*a*) casting soft metal around a master metal pattern, and (*b*) machining by conventional methods.

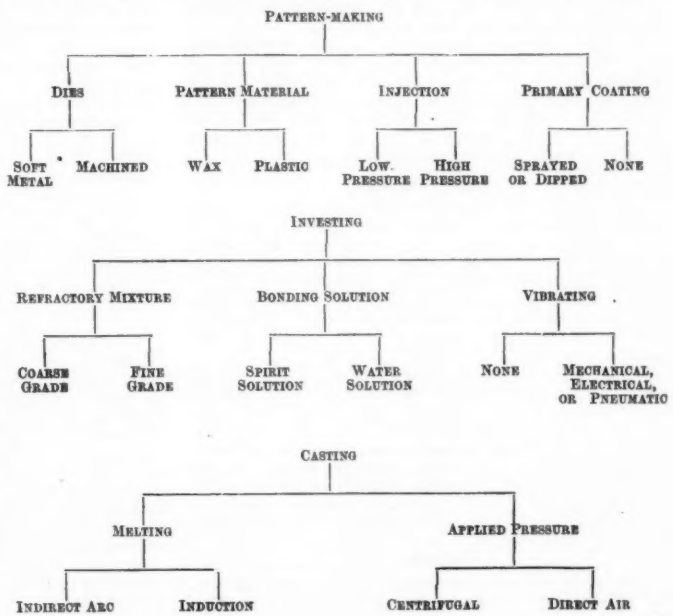
Soft Metal Dies

Soft metal dies are made of Wood's metal, type metal, Cerro alloys or other low-fusing-point alloys. The main advantages of using this type of alloy are their low melting point and the fact that they show a minimum of shrinkage upon solidifying and cooling. The most common method for making these mould cavities is by pressure casting and the most commonly used alloy is Cerro-Bend or Cerro-Base. A master metal pattern of the component is embedded in a matrix (usually plaster of Paris) to the parting line. It is then placed within a chamber capable of withstanding 80 lb. per sq. in. air-pressure, with the pattern extending upwards to act as a hob. The molten metal is poured into the chamber so as to cover the master pattern and at least 1 in. over the highest point of the pattern and the pressure is immediately applied to the metal.

The principal effect of this procedure is to cause the metal to cover thoroughly the surface of the master pattern, thus faithfully reproducing the contour and surface character of it. This method of die-making has certain advantages and disadvantages, but finds applications in probably 50 per cent. of all dies produced.

The main advantages of soft metal dies are:—(1) Reasonable accuracy; (2) easy material manipulation, making them ideal for development work; (3)

CHART No. I.—*Stages in the Investment Casting Process. Initially the process is divided under three headings: Pattern-making, Investing and Casting. These are then subdivided as shown.*



* A Paper read at Exeter before the Bristol and West of England Branch of the Institute of British Foundrymen

Investment Casting Process

total recoverable value of material after the die has worn out or become obsolete; (4) easily repaired when damaged, and (5) replacements are relatively cheap and easy.

The main disadvantages are:—(1) A master pattern must be provided which has all of the allowances for shrinkage (*e.g.*, pattern material and metal) built into it; (2) under heavy injection and clamping pressures they may creep or deform, and (3) they are easily damaged and cannot be roughly handled.

Machined Steel Dies

Machined steel dies are made by conventional machining methods direct from a blue-print. Because of this it is often more economical both in time and labour to embark upon this type of die. The time spent on making a master pattern for producing a soft metal die can be nearly the same as that to produce an injection die. This is often true whether or not long production runs are expected from the die.

The main advantages of this type of die are:—(1) High dimensional accuracy is attainable; (2) high injection and clamping pressures can be used; (3) not so easily damaged, thus minimising maintenance costs, and (4) excellent smoothness imparted on the surface of patterns.

The main disadvantages are:—(1) High production costs, especially for complicated components requiring a multiple piece die, and (2) duplicates or replacements show no saving over the first die.

In terms of broad generalities, it may be concluded that (1) for experimental and a great majority of medium runs, soft metal dies are preferred; (2) for long production runs and for many conditions, no matter how long the run, machined steel dies are to be preferred. The tendency is to use the higher grades of tool design and tool making skill.

Pattern Material

The selection of dispensable pattern materials is one which requires much thought and attention before a final decision is made. This is realised when it is pointed out that most pattern materials have their own individual shrinkage characteristics and allowances. Once production commences and dies have been made to specific dimensions, then a change in pattern material may mean a complete set of new dies.

The choice of a pattern material really rests between a wax or a plastic. Other materials, *e.g.* low melting-point metals, frozen mercury, etc., have been tried but for various reasons discarded. The most important characteristics of any pattern material are as follows: (1) Must volatilise completely from the mould, leaving no ash or residue; (2) must be sufficiently strong to withstand handling and subsequent vibration; and (3) possess low shrinkage characteristics after solidification.

Waxes

Wax is the material commonly used for the patterns, and although they may be produced in low cost dies, this material has a number of disadvantages at later stages of the process. Most pattern waxes consist of at least 50 per cent. specially prepared petroleum waxes, usually of the paraffin family, with additions of some or all of the following: carnuba, candelilla, beeswax, japan wax, synthetic resins, etc. With these materials a wide range of properties are possible, and the characteristics desired differ with the casting problems.

One important practical characteristic of an injection wax is melting point. The higher melting point waxes (65 to 90 deg. C.) offer a certain amount of industrial hazard in that an operator may get burned. There is also the greater difficulty of maintaining the correct injection temperature and the possibility of arranging for water cooling the injection dies. The low melting point waxes eliminate these difficulties, but may be more plastic at room temperature on hot days and lack a certain amount of strength. The best practical compromise is a wax with a melting point between 55 and 65 deg. C.

Another point at issue is whether to choose a wax having a sharp melting point or one with a wide softening range. Wide softening ranges are beneficial when it is desired to inject at varied but controlled temperatures, especially if low injection pressures are used. A sharp and narrow softening range is suitable for injection at constant temperature and higher pressures. It may be said that the higher the injection temperature and the greater the softness, the more rapidly will the die cavity be filled. The lower the temperature, however, the less shrinkage within the die and the higher the accuracy. Thus, the trend is towards injecting at softened rather than at fluid temperatures, but should injection be in the fluid range, the narrower the softening ranges the better.

Advantages of using wax as a pattern material are: (1) Excellent choice of a wide range of materials with special characteristics; (2) a considerable percentage of wax from the melt-out can be recovered; and (3) they can be easily joined and welded into casting formation.

The disadvantages may be listed as: (1) Easily damaged, and must be handled with care; (2) jigging of patterns is often necessary to prevent warpage; and (3) close temperature control of the injection room is vital for the maintenance of close tolerances.

Plastics

The plastic materials most commonly used as pattern materials are polystyrene, methyl methacrylate and polythenes. Polystyrene is favoured over others because it is economical, easily moulded on standard injection equipment, and is removed completely from the mould during the "burning out" operation, leaving no residue. If the part to be cast be so complicated that the pattern cannot be moulded in one shot without expensive tooling, the component may be moulded in two or more parts and joined together (using carbon tetrachloride as a cementing agent) to form the pattern for the ultimate casting.

Various points which differ from normal plastic moulding practice must be observed if every advantage is to be taken; *e.g.*, the ingates machined in the injec-

tion die must be of ample size,, since they must allow rapid fitting of cavities and maintenance of adequate pressure during the solidification stage to guard against shrinkage. This means that a longer time cycle is used than is customary in normal plastic moulding practice. The advantages of using plastic materials are: (1) They are not so fragile and withstand rougher handling, and (2) can be handled satisfactorily under normal atmospheric conditions.

The disadvantages may be listed as: (1) High melting point, making for practical difficulties; (2) not suitable for injecting into low-cost dies; (3) have no recoverable values; and (4) require expensive injection equipment.

Injection of Pattern Material

Direct pressure injection is the most adaptable method of moulding. The pressure can be applied by pneumatic or by hydraulic force. Pneumatic is generally more rapid in action, although hydraulic pressure is generally more sensitive in control. It is usual in many machines designed for injection moulding to apply pneumatic pressure for low-pressure injection and to use mechanical methods, *e.g.* pistons, for obtaining high-pressure injection.

It is necessary, whatever type of injection be used, that accurate control over the temperature of the pattern material must be maintained. The bulk tanks or primary working reservoirs can be controlled by circulating hot or cold water as desired, but resistance heaters are more sensitive for application to small areas, *e.g.* the injection nozzles.

Another important factor is that accurate control of velocity of the pattern material entering the die is necessary. If the material enters too quickly, air holes are usually present in the pattern. If it enters too slowly, then flow-lines or mis-runs are predominant. Between these two extremes there is obviously an ideal critical speed of injection, varying with the type of component being produced.

Low-pressure Injection

Low-pressure injection is carried out on a machine usually small enough that it is semi-portable, heated either by resistance heaters or hot water, with pressure applied pneumatically from a standard air line operating at 80 lb. per sq. in. The advantages of this type of machine are: (1) Economical and easy to manufacture; (2) very low maintenance costs; (3) adaptable for development work; and (4) can use low-cost dies with safety.

The main disadvantages are: (1) Complicated patterns of varying sections cannot be made successfully; (2) plastic pattern materials cannot be injected; and (3) the pattern material must be injected in its liquid state.

High-Pressure Injection

High-pressure injection really refers to pressures of 500 lb. per sq. in. and over. The types of machine generally adopted are those used for the injection moulding of plastics and which have been modified and re-adapted. The machine offering the greatest measure of control is the one normally used for extruding plastic materials on to wire.

The advantages of this method of injection are: (1) Complicated and heavy sectioned patterns can be made successfully; (2) a greater measure of control over the temperature of material and speed of injection is possible; (3) plastic or wax materials can be injected; and (4) material can be injected in the softened state.

The disadvantages are: (1) High initial cost of injection machine; (2) high maintenance cost; and (3) only machined steel dies can be used with safety.

Primary Coating

The function of a primary coating is to act as a barrier between the surface of the wax pattern and the coarse particles of the investment or moulding material, and is, within a certain measure, responsible for determining the surface finish of the final coating. The most important features of a primary coating are: (*a*) there must be no chemical reaction, slagging or oxidising material present, which may affect the metal itself, and (*b*) the particle size of the refractory material must be as fine as possible, preferably passing 300-mesh BS sieve.

Sprayed and Dip Coatings

The choice between a sprayed or dip coating is made in accordance with the ease with which air may be prevented from being occluded on the pattern and the speed and cost of application. If dipping be done, the wax assembly should be pushed carefully rather than plunged into the mixture, time being given to displace the air, yet, however carefully this be done, the elimination of every small air bubble is practically impossible. A sprayed coating certainly produces the most consistent results and castings with a smoother surface.

The thickness of this primary coating is usually of the order of 0.010 to 0.020 in. for a sprayed coating and 0.040 to 0.060 in. for a dip coating. Whilst still moist, the coating is sometimes covered with a coarse-grained refractory material, generally having a grain size of +100 mesh BS sieve. The purpose is to provide a better bonding agent for the main body of investment material.

Any high-grade refractory material may be used as a filler, but the usually accepted ones are either silica, magnesia, alumina or zirconia. These are bonded with an organic silicate-alcohol mixture or a sodium silicate: water solution.

The advantages of using a primary coating is that a smooth surface finish is imparted to the castings. The disadvantage of using a primary coating is that an extra operation is required to the process and extra time is consumed during the drying period.

Elimination of the Primary Coating

The elimination of the necessity of applying a primary coating has always been an ambition, but never a practical proposition. The reasons for this is that it means the utilisation of very fine-grade investment or moulding materials, which bring further complications into the process—*e.g.*, increased vibrating

Investment Casting Process

and settling times, greater tendency for mould cracking, etc. The surface finish of resultant castings rarely compares favourably with those cast into moulds which have received a primary coating, especially if large surface areas with considerable overhang be involved. The coarse particles of refractory segregate under these surfaces and are left in relief to impart a rough surface on the casting.

Refractory Mixtures

The refractory mixtures originally recommended consisted of various ratios of silica flour, silica sand and crushed firebrick. Such mixtures were satisfactory, but owing to the risk of silicosis being contracted by the operators, these materials have been abandoned in favour of the alumina-silicate sands, of which "sillimanite" is probably the best known. The type and grading of refractory mixture used varies with the technique of casting which is to be employed—*e.g.*, a coarse, open refractory is most suitable for gravity casting, but a fine, dense refractory can be employed when pressure casting is used. With the majority of casting taking place while the moulds are at elevated temperatures (up to 1,000 deg. C.), the question of permeability of the mixture is not so critical as is experienced in normal foundry practice. Usually, the choice of refractory is dictated by other requirements.

Coarse-grade Refractories

Some qualification is needed to define a coarse-grade refractory suitable as a moulding material for investment casting. All sand grains retained on 60 mesh BS sieve are termed coarse, between 100 and 200 mesh as medium grains, and those passing 200 mesh as fine. A typical sieve analysis for a coarse-grade refractory is:—

B.S. Sieve No.		Per cent. retained.	
	+ 16	0.02	
− 16	+ 22	0.06	25.45
− 22	+ 36	1.41	
− 36	+ 44	8.20	
− 44	+ 60	15.76	
− 60	+100	17.66	
−100	+150	19.03	50.45
−150	+200	13.76	
−200	+300	8.10	24.10
	−300	16.00	

The advantages of using a coarse-grade refractory are: (1) Vibrating and settling times are considerably reduced; (2) heavy sections can be gravity cast successfully; and (3) there is less tendency for mould cracks to be produced.

The disadvantages are: (1) The moulds are weak and friable at high temperature; (2) a considerable amount of settling of the coarse grains occurs during the investment mixing operation; and (3) segregation of the coarse grains takes place close to the pattern during the moulding operation and gives poor mechanical support to the primary coating.

Fine-grade Refractories

The elimination of all grains over 60 mesh produces a sand much finer in texture and gives a hard, dense mould. A typical sieve analysis of this type of sand is:—

B.S. Sieve No.		Per cent. retained.	
	+ 16	Nil	
− 16	+ 22	Nil	
− 22	+ 36	0.05	0.42
− 36	+ 44	0.05	
− 44	+ 60	0.32	
− 60	+100	13.35	
−100	+150	21.08	52.98
−150	+200	18.55	
−200	+300	13.42	46.60
	−300	33.18	

The advantages of using a fine-grade refractory are:—(1) A harder and stronger mould is produced; (2) excellent mechanical adhesion and support is given to the primary coating, and (3) good smooth mixing with the bonding solution is obtained.

The disadvantages are:—(1) Increased settling and vibrating times are required; (2) there is greater possibility for mould cracks to be produced, and (3) the method is only suitable for pressure casting, especially when attempting thin sections.

Bonding Solution

The procedure of making additions of a bonding solution to the sand mixture prior to investing is still in general practice. Various materials suitable for bonding have been suggested from time to time, but the most important and the ones in general use are:—(*a*) Ethyl silicate, and (*b*) hydrous silica sol. The reason that the silicates are so useful in this particular field is that upon reacting with accelerating agents, *e.g.*, MgO, sodium aluminate, etc., silicic acid is produced which, upon heating, is converted into SiO_2.

Spirit Solution

Ethyl silicate is invariably used as a spirit solution. It is hydrolysed with dilute HCl and diluted to a suitable strength with alcohol (methylated spirits). The neat ester contains approximately 40 per cent. silica, and this can be diluted to give a total silica content of approximately 12 to 18 per cent., which is adequate for producing satisfactory moulds using both a coarse or fine refractory mould material.

The advantages of using a spirit bonding solution are:—(1) Rapid rate of drying in the initial stage of mould curing, and (2) facilitates a quicker vibrating and settling period during moulding.

The disadvantages are:—(1) Alcohol is an expensive dilutent; (2) arrangements must be made for adequate ventilation and fire-proofing in the moulding room, and (3) suitable fire precautions must be taken in the low-temperature drying oven.

(To be continued)

A Decade of Progress in British Ironfounding*

By W. W. Braidwood

(*Slightly abridged.*)

(*Continued from page* 260.)

Finishing Methods

Cleaning methods have been greatly improved. The manually-operated pneumatically-served blasting room has given way, in the case of light and medium castings, to the airless impeller-served unit of the revolving-barrel, turntable or tunnel type. For the cleaning of medium and heavy castings the Hydro-Blast method has evidently come to stay, and in Britain there are now six such plants in operation in iron foundries, with three further installations pending. Their advantages with regard to cleanliness, efficiency of cleaning and recovery of graded sand have been described.[21] Fig. 10 shows the technique of Hydro-blast operation.

Working Conditions

The move towards more efficient and more hygienic methods of cleaning castings is only part of the general upward trend in foundry conditions. In 1947, "The Garrett Committee," representative of employers' federations, trade unions and H.M. Factory Inspectorate, published its report[22] which contains many recommendations for improvement of working conditions and emphasises the need to reduce dust and fumes and to provide adequate washrooms. Recommendations to be observed in the construction of new foundries are also embodied.

This determination to improve foundry conditions is not being imposed from outside, but has originated and is being fostered within the industry, as is shown by the fact that in 1946, a competition for awards, given the name of the late F. J. Cook, a founder-member of the Institute of British Foundrymen, invited suggestions for improvement of foundry conditions.

Recruitment and Training

There has been simultaneous realisation of the need for improved methods of training foundry personnel and for attraction of worthwhile recruits to the industry. With these dual aims, many firms have provided facilities for systematic practical and theoretical training of young moulders, patternmakers and technicians. Moreover, under the provisions of the 1944 Education Act, young persons between school-leaving age and 18 years are enabled to study one day per week at the Technical School provided in each industrial area. The British Foundry School, which was closed in the war years, has been revived as the National Foundry College, and, with headquarters in Wolverhampton, has recommenced the training of potential foundry executives. There has been greatly increased use of the film as an aid to instruction. Reference has been made to two outstanding examples, but many other films have been and are being, prepared. The film-strip, too, is much in use, especially in training centres and technical schools.

Technology

Excellent work has been done by the various sub-committees of the Technical Council of the Institute of British Foundrymen. It has been possible in this Paper to refer to the work of only six of these committees, but altogether about thirty have functioned in the last ten years. The two committees most recently formed are studying, respectively, the best methods of utilising available materials in cupola charges, and the possibility of standardising moulding-box equipment.

The British Cast Iron Research Association has continued to grow in size and to rise in status and in 1942 moved to larger and more suitable premises at Bordesley Hall, Alvechurch, near Birmingham. While the work of the Association must always be regarded as that of a team, it will not be amiss to single out for special mention the individual contributions of H. Morrogh, whose researches on the metallography of cast iron in general and graphite formation in particular are universally recognised.

Special Irons

Application of special-purpose irons has expanded and increased and the successful production, for the chemi-

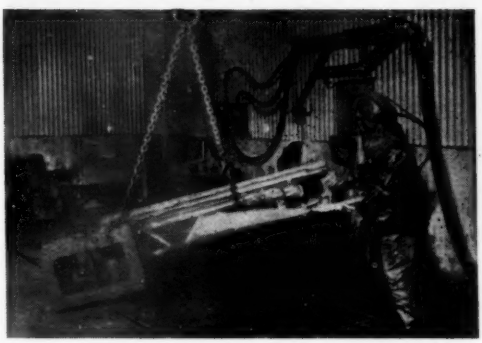


FIG. 10.—MACHINE-TOOL CASTINGS BEING CLEANED BY HYDRO-BLAST.
[*Courtesy of John Lang & Sons, Limited*]

* A paper presented to the 1948 Annual Meeting of the *Association Technique de Fonderie*, Mr. A. le Thomas and Mr. V. C. Faulkner presiding. Later given before the Falkirk Section of the Scottish Branch of the Institute of British Foundrymen. The author is on the Research and Development Staff of the Mond Nickel Company, Limited.

British Ironfounding

cal and allied industries, of large castings in corrosion-resisting austenitic irons has been noteworthy. Fig. 11 shows two absorber trays, each about 9½ ft. in diameter and approximately 3½ tons in weight, used for handling acetone and acetic acid, while Fig. 12 depicts a still top of 9 ft. dia. and 4½ tons weight, used in manufacture of glycerine.

For resistance to high-temperature conditions, wide use is made of Nicrosilal and Ni-Resist, and modifications of the irons. Thirty per cent. chromium cast iron is also used, but the difficulties of production are causing this material to be less popular. Particularly encouraging results are currently being obtained, in suitable applications, from special higher-chromium grades of Ni-Resist. For castings of the hard, wear-resisting types the martensitic white cast iron, Ni-Hard, is in increasing use. Fig. 13 illustrates some well-established applications, namely, miscellaneous castings used in clay-working and brick-making plants.

High-strength Irons

It is in the field of the high-

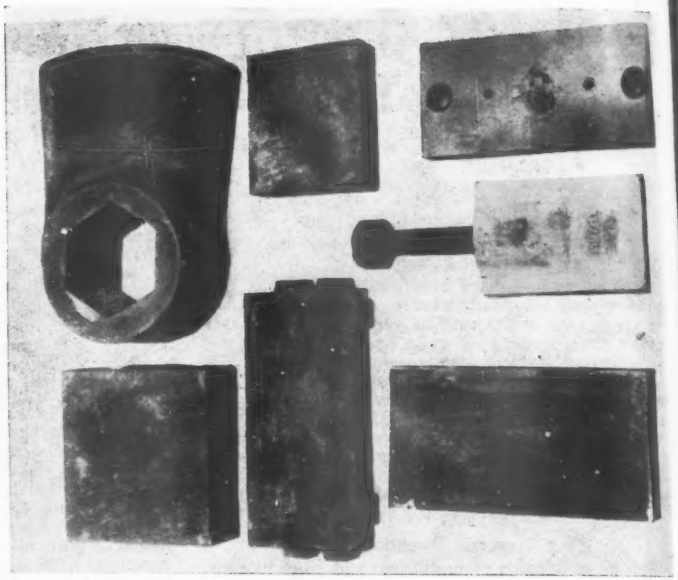


FIG. 13.—GROUP OF NI-HARD CASTINGS USED IN CLAY-WORKING AND BRICK-MAKING PLANTS.
[Courtesy of John Williams & Sons (Cardiff), Limited]

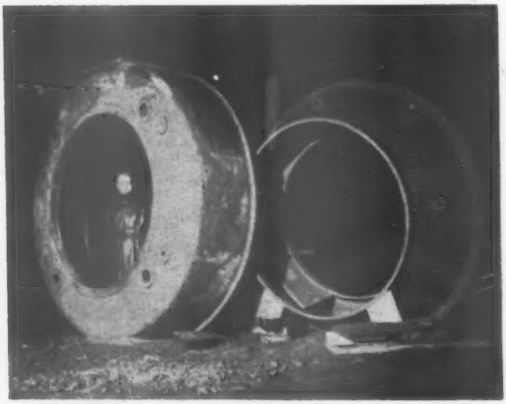


FIG. 11.—ABSORBER TRAYS IN NI-RESIST.
[Courtesy of Sheepbridge Stokes Centrifugal Castings Company, Limited]

FIG. 12.—STILL TOP IN NI-RESIST.
[Courtesy of A. F. Craig & Company, Limited]

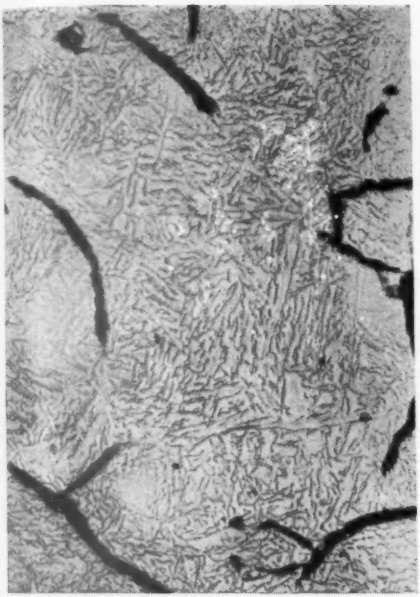


FIG. 14.—TYPICAL STRUCTURE OF ACICULAR CAST IRON. ETCHED. × 500.

strength irons that the most outstanding metallurgical progress has been achieved. Striking advances have been made along two lines:—(1) Improvement of the metallic matrix, and (2) improvement of the graphite form. Under the first heading, alloying has been more and more effectively employed, the greater use of alloys having been associated with a move from high-strength irons of low-carbon content to those with carbon in the range 2.9 to 3.2 per cent. and with correspondingly greater ease of founding.

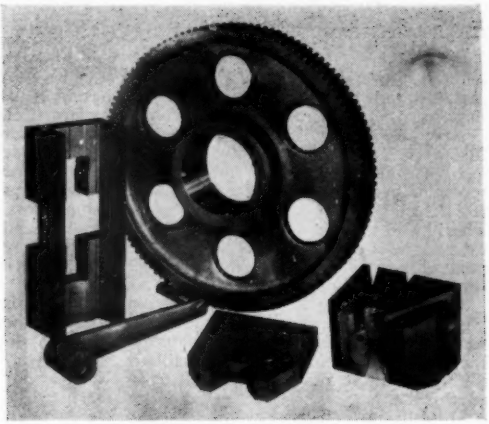


FIG. 15.—GROUP OF MACHINE-TOOL DETAILS IN HIGH-DUTY CAST IRON.
[Courtesy of S. Russell & Sons, Limited]

The nickel-molybdenum combination has come into greater use for production of either pearlitic irons satisfying B.S.S. 1452, Grade 23, as-cast, and heat-treatable to give high-hardness without drastic quenching, or acicular irons to meet the highest specification (26 tons per sq. in.), as-cast, or after low-temperature treatment. Acicular iron* contains nickel and molybdenum in amounts so adjusted as to prevent breakdown of austenite at the temperature of pearlite-formation and induce transformation in the intermediate range at approximately 400 deg. C., to give needles of ferrite in austenite. Fig 14 illustrates the typical structure of acicular cast iron, which is characterised not only by high strength in tension, but also by marked resistance to impact, in association with hardness up to 340 Brinell, at which figure machineability is retained. These developments were, of course, greatly speeded by the demands of the rearmament programme initiated in 1938, when to peace-loving Britain came the realisation that war had become more than just a possibility. This programme,

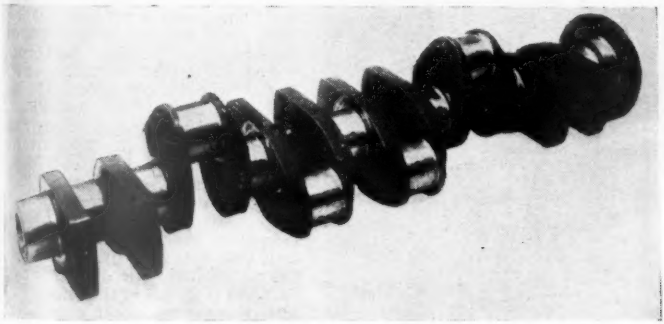


FIG. 16.—CRANKSHAFT IN ACICULAR IRON FOR SIX-CYLINDER DIESEL ENGINE DEVELOPING 240 B.H.P. AT 1,500 R.P.M.
[Courtesy of National Gas & Oil Engine Company, Limited]

*British Patent No. 545,102.

Progress in British Ironfounding

intensified and accelerated on the actual outbreak of war, severely taxed the resources of the steel industry and, as a natural sequence, castings in high-duty iron were, wherever possible, used to replace steel.

New fields of application for cast iron, opened under the stress of war, but now well established, include gears, spindles, racks, cams and tool-holders in machine tools, crankshafts, camshafts, heads and rocker arms for Diesel, petrol, oil and gas engines and compressors, wheel-hubs, sprockets and winch-drums for tractors and excavators, and side frames, dies, liners and piercing points for forging and extrusion presses. Figs. 15 to 18 show typical examples of such applications.

The trend, however, has not been entirely towards greater use of iron castings. In the early period of the war, near-miss bombs and other non-contact explosions were found to cause considerable damage to warships and vessels of the mercantile marine and, as far as possible, engines and ancillaries had to be made of steel. This field will be wholly recovered only when grey cast iron with measurable ductility becomes readily available. That day is almost here! The progress made in control of flake-graphite form and distribution has been considerable, and it is only fair to record

FIG. 17.—(RIGHT) SPROCKET WHEEL AND CABLE DRUM IN PEARLITIC NICKEL-MOLYBDENUM IRON FOR AN EXCAVATOR.
[Courtesy of S. Russell & Sons, Limited]

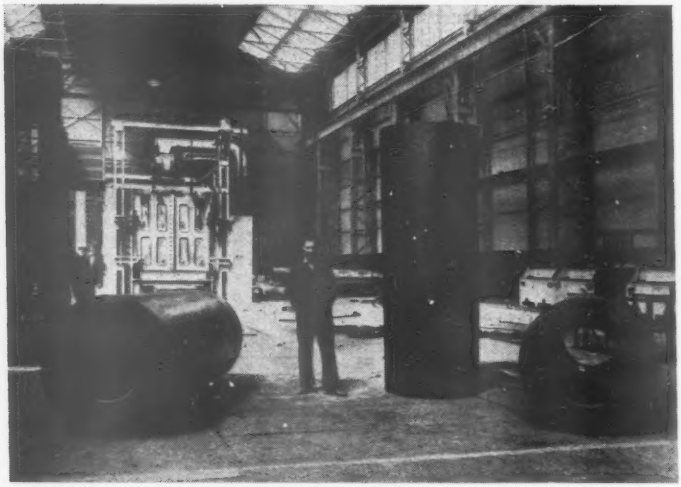


FIG. 18.—LINERS IN ALLOY CAST IRON FOR A SHELL-FORGING PRESS.
[Courtesy of Brightside Foundry & Engineering Company, Limited]

with gratitude the help received from the metallurgists of the U.S.A. The Annual Conference of the American Foundrymen's Association in May, 1941, was particularly productive of Papers of outstanding interest.[33 34 35] The most important fresh information then given on the mechanism of formation of graphite was contained in the excellent Paper by Eash,[35] who demonstrated that low-carbon irons, when inoculated, freeze at higher temperatures and exhibit shorter eutectic arrests than untreated irons of identical composition. These differences in behaviour were observed to coincide with the production of (1) normal flake graphite in random distribution (Fig. 19) and (2) fine flake graphite in inter-dendritic distribution (Fig. 20) in the respective sets of test-bars. Eash concluded that grey irons with flake graphite in random arrangement solidify in the stable iron-graphite system, whereas those with fine graphite in

an inter-dendritic pattern solidify as white irons, the meta-stable eutectic carbide subsequently decomposing to form iron and graphite.

Eash's finding was not at first accepted in influential quarters in Britain, the view being taken that his conclusions were illogical.[36] It was argued that the formation of a carbide would be unlikely in irons of the 14 per cent. silicon type, which are prone to exhibit fine graphite in inter-dendritic pattern—the so-called "undercooled" graphite. However, subsequent research carried out by the British Cast Iron Research Association confirmed Eash's findings, even in the particular instance quoted, and his explanation of the formation of "undercooled" graphite, now fully accepted, has done much to advance understanding of the subject. The more recent discoveries can only be described as revolutionary and seem destined to place at the disposal of industry a new material with exceptional properties. Morrogh and his collaborators have described development of a process for production of nodular graphite in cast iron by addition of cerium, and have reported the properties obtainable.[37 38 39] By thus improving the form of the graphite, and so reducing its weakening effect on the matrix, astonishing increases in tensile strength and toughness are achieved. The cerium process may have limitations, however, since its application is restricted at present to hyper-eutectic irons of low sulphur content which can be produced commercially only by the employment of expensive charge materials and by special treatments. Development of a further method, which uses magnesium added as a nickel-magnesium alloy, has also been announced.[40] This process, which is applicable to a wider range of compositions, produces spheroidal graphite. These developments are exposing vast new fields for exploration and exploitation by the ironfounding industry. Grey cast iron with tensile strength of 45 tons per sq. in. is here, and the iron of 60 tons per sq. in. and higher strength is just around the corner. Moreover, by heat-treatment of only a few hours' duration, substantial elongation values can be obtained. It may be said, therefore, that this period ends and a new one opens with the advent of a new material offering to the engineer exceptional mechanical properties capable of variation over a considerable range.

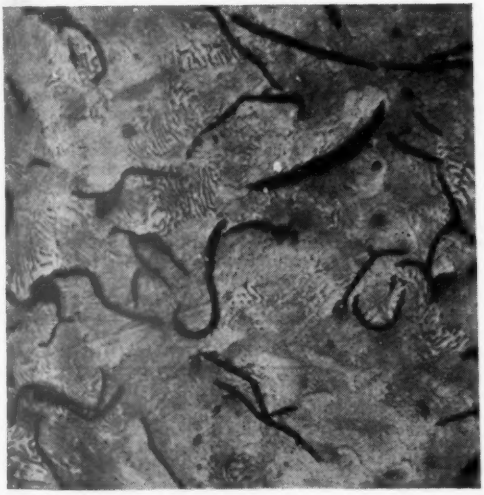


FIG. 19.—NORMAL FLAKE GRAPHITE IN RANDOM DISTRIBUTION IN A PEARLITIC MATRIX. ETCHED. × 250.

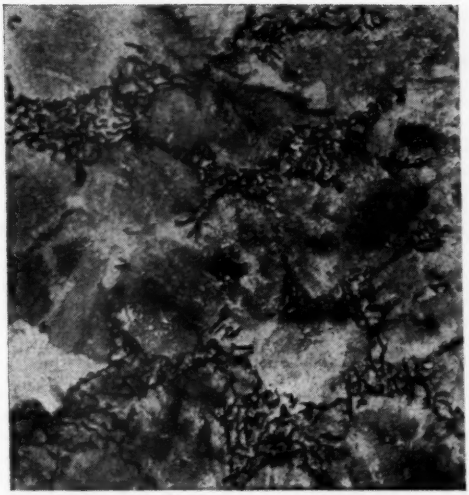


FIG. 20.—FINE FLAKE GRAPHITE IN INTER-DENDRITIC DISTRIBUTION IN PEARLITIC MATRIX. ETCHED. × 250.

The author acknowledges his indebtedness to the Mond Nickel Company, Limited, for permission to publish this Paper.

REFERENCES

31 "Application of Hydro-Blast to Dressing and Sand Recovery," by Buchanan, W. Y., *Proc. Inst. Brit. Foundrymen*, 1946-47, XL, B110-B119.

32 "Report of the Joint Advisory Committee on Conditions in Iron Foundries," published by H.M.S.O., 1947 (see FOUNDRY TRADE JOURNAL, 1947, LXXXII, 289).

33 "The Solidification and Graphitisation of Grey Cast Iron," by D'Amico, C. D., and Schneidewind, R., *Trans. Amer. Foundrymen's Assocn.*, 1941, XLVIII, 775-803.

34 "Some Factors Influencing the Graphitising Behaviour of Cast Iron," by Massari, S. C., and Lindsay, R. W., *Trans. Amer. Foundrymen's Assocn.*, 1942, XLIX, 953-985; disc., 985-991.

35 "Effect of Ladle Inoculation on the Solidification of Grey Cast Iron," by Eash, J. T., *Trans. Amer. Foundrymen's Assocn.*, 1942, XLIX, 887-906; disc., 906-910.

36 Discussion of "Cupola-Melted High-Duty Cast Irons," *Proc. Inst. Brit. Foundrymen*, 1941-42, XXXV, 215-216.

(*References concluded overleaf at foot of column 2*).

Book Review

Industrial Hygiene and Toxicology, Vol. I. Edited by Frank A. Patty and published by Interscience Publishers, Limited, 2A, Southampton Row, London, W.C.1. Price 60s.

This book is of American origin, but as it does not enter into the legal aspects of industrial hygiene or their neglect, it is equally acceptable to domestic readers. As the foundry industry is at the moment especially interested in the determination of carbon monoxide in shop atmospheres, the reviewer carefully studied the paragraphs dealing with this subject. It seems that the Americans use an apparatus called the Hopcalite. This apparatus catalyses the union of CO with O to form CO_2 and the heat generated by this reaction is converted to electrical energy by the thermopile and registered by a recording potentiometer or millivoltmeter. This machine is somewhat delicate and requires meticulous maintenance. It should be standardised against mathematically exact mixtures.

There is a substantial section devoted to dust counting, with many references to foundry conditions. Two chapters, five and ten, have been written by Mr. W. N. Witheridge, and both are excellent. The former deals with "Environmental Factors in Fatigue and Competence," and the latter with "Ventilation." For those working in a hot atmosphere and consequently losing salt through perspiration, the Author recommends the taking of five to ten 10-grain tablets of sodium chloride per day. If salinised water be preferred, then a salt concentration of 0.1 to 0.2 per cent. is suggested. The section on lighting and amenities seems to accord with current British views, but in connection with washing and bathing facilities, the reviewer prefers many domestic layouts to the one illustrated. There is, however, a novel feature, that of grouping five showers in the form of a circle, much as is done here with the semi-communal wash basins. It is certainly a worth-while space-saver. In the chapter on ventilation, the Author discloses a number of ideas useful for the improvement of foundry atmospheres. For instance, there are shown details of arrangements for ventilating the ends of conveyor belts, for exhausting fumes and dust emanating from arc-type electric melting furnaces; and several methods—some novel—for ventilating knock-outs.

In Tables XV and XVI (pages 312 and 313), very useful data are given for air exhaust speeds for many industrial applications. Quite frankly, the reviewer found Chapter XI covering Occupational Dermatitis rather too technical for the lay reader, and he has been left with the impression that most things, from hops to hogs' intestines, seem to be suspect. The following chapter, "Visible marks of occupational diseases," was found to be positively macabre, and is no doubt meant for study by the medical fraternity only. There is a long chapter on hazards resulting from combustible gases and vapours, replete with very extensive tables giving their ignition temperatures and so forth. A second section of this chapter, of interest to the National Coal Board, carries the subject to combustible dusts. A chapter on respiratory devices is sandwiched in between these sections and an erudite dissertation on "Dust in the Causation of Occupational Diseases." It is in like measure helpful to the industrialist and to the physician, though it is a difficult subject, for apparently a section of the population is allergic to such conditions, and, moreover, blame for incidence of disease can and is being wrongly ascribed.

This is a comprehensive and a well-nigh exhaustive treatise on the subject of industrial hygiene, and the reviewer doubts whether another book could be found containing such a mass of information on a subject which will attract increasing attention with the intensification of industrial production. It is not a cheap book, but it is invaluable to those responsible for the conduct of large-scale enterprises.

V. C. F.

B.I.S.R.A. Exhibits at Imperial College

The British Iron and Steel Research Association is showing five instruments at the Physical Society's Exhibition at Imperial College, Kensington, from April 5 to 8. They include a thickness gauge; a four-channel electrical resistance strain gauge; plastic replicas for the examination of metal surfaces; a sensible heat meter, and a dust meter.

The Association is actively concerned in the investigation of silicosis in steelfoundries, and the dust meter which is shown makes use of the Tyndall beam effect for comparative estimation of the dust concentration in air or gas atmospheres. A 30-watt filament lamp and lens system forms an intense and sharply defined divergent light beam which is passed axially through a cylindrical glass-walled sampling chamber. A sample of the atmosphere being analysed is continuously drawn through the sampling chamber by a motor-driven suction fan. The light scattered in a direction approximately normal to the illuminating beam is measured by four photo-multiplier cells which are positioned around the outside of the glass-walled chamber. Even a puff of cigarette smoke drawn into the instrument to be shown at the exhibition gives a clear reading on the micro-ammeter connected with the photo-multiplier cells.

Progress in British Ironfounding

References concluded from p. 287

37 "Graphite-Formation in Cast Irons and in Nickel-Carbon and Cobalt-Carbon Alloys," by Morrogh, H., and Williams, W. J., *Jnl. Iron and Steel Inst.*, 1947, CLV, 321-371.

38 "The Production of Nodular Graphite Structure Cast Iron," by Morrogh, H., and Williams, W. J., *Jnl. Iron and Steel Inst.*, 1948, CLVIII, 306-322.

39 "Nodular Cast Irons: Their Production and Properties," by Morrogh, H., and Grant, J. W., *Inst. Brit. Foundrymen*, Paper No. 898, June, 1948, 22 pp.

40 Discussion on "Production of Nodular Graphite Structure Cast Iron" (Item 38 above), FOUNDRY TRADE JOURNAL, 1948, LXXXIV, 463.

The Addition of Oxygen to the Cupola Blast*

Cheaper Oxygen and Modified Cupola Design are required

By J. Blakiston, A.M.I.Mech.E.

Considerable interest has been aroused in foundry circles by the suggested application of oxygen additions to the cupola blast to try to achieve some improvement in the over-all efficiency of the cupola. Several theoretical Papers have been published on this subject, but up to the present very little practical work has been carried out under commercial operating conditions, and it would be of general interest to try to approach this subject from the operational side and balance the facts with some of the theoretical findings to date.

Potential Savings

An elementary school experiment will provide an approach to the subject. This experiment is that which demonstrates the composition of air by igniting phosphorus in a sealed jar inverted over a water trough. After the phosphorus has consumed all the oxygen in the jar, the water rises, indicating that, of the volume of air only one-fifth, *i.e.*, the oxygen content, would support combustion, the remaining four-fifths being inert gases, mainly nitrogen.

Comparing this experiment with cupola operation, it will be seen that of the volume of the air generally taken at 14 cub. ft. per lb. of iron melted, four-fifths of this, or approximately 11 cub. ft., represents nitrogen, which has no influence on the combustion of the coke and will have a definite cooling effect on the operation of the cupola. This fact accounts for the marked influence which small oxygen additions have on the furnace operation when even as little as 2 per cent. is introduced into the blast. An addition of 5 per cent. oxygen to the blast represents the equivalent of an increase of 25 per cent. of air blown in to the cupola. An alteration of this nature can produce an entirely different set of melting conditions, and it is obvious that a cupola of an entirely new design, both as regards operational dimensions, lining cooling facilities and charging heights will be required to operate this method to obtain the maximum results. It would be possible to concentrate the cupola capacity into a much smaller space, with an intense output from the melting unit.

Modified Cupola Design

It will give a false picture of potentialities if oxygen be added to an existing cupola and the results obtained are merely compared with the previous results without taking into account the innumerable additional factors created. Developments of the system indicate that small units of extremely high melting capacity would be evolved, having a very high operational efficiency, but somewhat complicated by the cooling and control mechanisms which would be required. Another important factor is the cost of oxygen. The commercial oxygen, as supplied to-day, is too pure for this purpose, and has therefore a correspondingly high manufacturing cost. A supply of cheap oxygen to a less rigid specification would enable development work to be carried out on a commercial scale.

Advantages and Disadvantages

The advantages and disadvantages of oxygen addition can be set out as follows:—

Disadvantages.	*Advantages.*
(*a*) Cost of oxygen.	(*a*) Smaller unit per ton hour.
(*b*) Increased lining wear.	(*b*) Fuel economy.
(*c*) Increased technical supervision.	(*c*) Blast economy.
(*d*) Greater chance of damage and defective castings through mis-management.	(*d*) Hotter metal.
	(*e*) More versatile metallurgical control.

Under the heading of "Disadvantages," the increased lining wear would only be applicable when comparing furnace size against a furnace of similar dimensions utilising oxygen. It is most likely when comparing capacity for the two processes with a correctly designed furnace, utilising oxygen additions with a thin, water-cooled lining, that the wear would be less in the latter case. An assessment of the commercial possibilities of oxygen additions up to the present stage of development, can be stated as follows:—

(*a*) The addition of oxygen for the routine melting of standard grey iron would not be justified unless the cupola was specially designed and oxygen was available at a considerably lower price than rules at present.

(*b*) The installation of plant permitting oxygen additions to be made to existing cupolas would be justified, and be a commercial proposition for the correction of a temporary phase of unsatisfactory cupola operation, or to produce a set of melting conditions required by special metallurgical considerations.

The above brief remarks should convey an outline of the principles of oxygen enrichment. Observations from the members, both critical and otherwise, should help in forming an opinion as to the further potentialities and possible developments of this process.

DISCUSSION

MR. NICHOLLS said this subject of enrichment of the blast was one that was coming very much to the

*A Paper read before the West Riding of Yorkshire Branch of the Institute of British Foundrymen.

Oxygen Additions in the Cupola

fore, judging by recent articles in the Press. If anyone thought that benefit could be obtained by turning on an oxygen tap into the windbelt, he would probably be risking the occurrence of many troubles. The subject would have to be gone into very carefully, and if one bore in mind the points for and against, as set out in the Paper, one would see each one had a subsection attached to it. There would only be lower metallic losses and other benefits provided that the control of the cupola was more rigid than it was to-day, on account of the higher temperatures and the amount of free oxygen present. Mr. Blakiston had not detailed the actual oxygen costs—an important factor when considering the process. One potential advantage was a possibility of quickly bringing the furnace back to normal, when operational trouble has been experienced, by adding a percentage of oxygen to the blast for five minutes or more. Many cupolas to-day, working under proper control, gave good hot iron economically, and he would like to hear Mr. Blakiston's opinion as to what demands would warrant a higher metal temperature.

Oxygen Price Level

MR. BLAKISTON, in reply, referred to the cost of oxygen, and pointed out that if inferior grade oxygen were available at, say, 15s. per 1,000 cub. ft. the process could be rendered a commercial proposition for consistent application of oxygen. He believed at the present moment the cost of oxygen in bottles was about double this figure. He agreed with Mr. Nicholls that oxygen additions would demand a very exacting cupola control, misjudgment would create damage within a matter of seconds. Even at the present time, a well-run foundry would benefit from a correctly designed installation permitting oxygen additions to be made to the cupola to permit the correction of working irregularities. If it was possible to add even as little as one per cent. to individual tuyeres, "black" tuyeres could be corrected and much smoother and regular working could be obtained. If a cupola became "stuck-up" during present operating methods, one might have four or five men working hard to free it, resulting not only in the loss due to stoppage, but also an unnecessary addition to the wages bill. The cost of a bottle of oxygen would be a fraction of these costs.

Method of Adding Oxygen

MR. ANDERSON asked for Mr. Blakiston's opinion as to the best possible place for the introduction of oxygen to the cupola blast, whether this should be the blast pipe or in the tuyeres. In the case of lining wear, would not this be reduced if the furnaces were operated at a lower blast pressure in conjunction with the oxygen additions?

MR. BLAKISTON, in reply, said that if an installation for oxygen addition had to be made, and he had no published information to refer to, he would suggest running a small pipe, no larger than ¼ in. diameter, to the top of each tuyere, each pipe connection having a small valve interposed. The oxygen was much heavier than the air, and would fall into the blast stream, thus being intermixed. The oxygen supply would be *via* a reducing valve which would limit the pressure to 5 lb. per sq. in. maximum. He thought it would be dangerous to add the oxygen to the blast main; apart from this there would not be the desirable control to each individual tuyere. It should be possible to install the equipment as described for as little as £50. A person designing a cupola for continuous oxygen additions would probably find that he would need a much smaller stack diameter and lower air pressures for quite large outputs. Probably a much more expensive type of refractory would be used backed by water cooling, and it was quite possible that the lining consumption on this type of furnace might be less than that usually experienced on the standard cupola when rated per ton output.

Importance of Cupola Stack Height

MR. SUNDERLAND stated that he considered that the stack height of a cupola using oxygen-enriched blast would be a very important factor, as with the increased melting speed, metal would pass down the stack at a faster rate than it could absorb the heat, unless the design took this factor into consideration. The improvement in operation of a standard cupola which was attributed to oxygen additions, might possibly have been achieved merely by correcting the stack height, which may have been too low.

MR. BLAKISTON thanked Mr. Sunderland for raising a very important factor, which he must admit he had overlooked. This factor would have to be taken into consideration when designing a cupola to work with oxygen-enriched blast. The heat absorption rate of iron is slower than many people realise. Experiments conducted in a rolling mill showed that ingots being re-heated were liquid on the outside, after five hours' heating, while the interior of the ingot was still black. A piece of iron passing down the cupola at a quicker rate than it could absorb the heat for complete liquefaction would drop below the tuyeres, and cause trouble. It would be necessary to reduce the oxygen-enriched blast pressure to establish sufficient time for the metal to absorb, between the charging hole and the combustion zone, the required amount of heat for melting.

At the conclusion of the discussion Mr. Nicholls proposed a vote of thanks to Mr. Blakiston, which Mr. Simpson seconded and the meeting cordially endorsed.

Death of Mr. A. E. Chell

The death occurred last week of Mr. A. E. Chell, M.I.Mech.E., M.I.B.F., who was well known in foundry circles as joint director for iron castings during the war. For many years he was a director of the Rodney Foundry Company—one of the foundries to be bombed out of existence during the "blitz" on London. In the 1920's, Mr. Chell was chairman of the foundry section of the Engineering and Allied Employers' London and District Association. During the last few years he practised as a consulting engineer, specialising in the modernisation of foundries.

The Development of Inventions

By F. J. Tebbutt

An Act which is designed to develop and exploit inventions is the Development of Inventions Act, 1948, and its objects follow, somewhat, suggestions made by the Parliamentary Scientific Advisory Committee, and by the Swan Committee on the law of Patents; it is really complementary to the Patents Acts, no alterations being made by this measure to those Acts.

Powers of New Corporation

Under this new Act is formed the National Research Development Corporation, which can operate for (*a*) inventions resulting from public research and (*b*) in respect of other inventions where it appears that they are not being developed or exploited; in both cases, however, action can only be taken if it is considered that public interest so requires. Under (*b*) cases could be dealt with where an inventor cannot proceed with his invention owing to want of cash, etc., but it should be noted that while the Corporation can negotiate for private inventions it cannot compel an inventor to sell; it can give financial assistance to such persons (explained later) and help him to apply for a patent.

For public research inventions, the Corporation has the power to acquire, hold, dispose of, and grant rights (whether gratuitously or for consideration) and for other inventions it has similar powers if it is considered that public interest so requires. The Corporation has general powers to carry on any activity, which appears to be requisite, advantageous, or convenient for the exercise of their functions, or is incidental or conducive thereto. They can, if within the provisions of the Act as above, carry on or promote, or facilitate the carrying on by other persons of any business, but they must—unless there are special circumstances—entrust, on appropriate terms, the exploitation of any invention to persons engaged in the industry concerned.

Board of Trade Approval

It will be seen from the foregoing, that the Corporation have rather wide powers, as, for example, they can buy, sell, or rent premises or plant, and so long as they are within the powers quoted previously, they can mostly act the same as any commercial concern; but for some things, as, for instance, in the formation of new companies, approval of the Board of Trade is required. Thus the Act specifically mentions that approval of the Board is required for the carrying out or the entering into any agreement for the carrying out on behalf of the Corporation of any project for the making of goods, the construction of works or the provision of premises, or the setting-up by the Corporation of any company or other organisation for carrying out any such project, but it should be noted that as regards such matters approval is not required for anything done by way of experiment or trial. Approval is required also for the acquisition of, or of any interest in, any undertaking.

Financial assistance can be given by the Corporation to any person for the development or exploitation of an invention, if the amount does not exceed £500 in any year, but for anything over £500 a year, approval of the Board of Trade is required.

Matters of Substance

It might be useful to note that under the powers given the Corporation to develop inventions by experimental or pilot-scale operations, they can make goods, construct works, or promote services, provided what is done is within the powers of trial or experiment, and otherwise only if the Board of Trade approves. Public research inventions can be patented by the Corporation at home or abroad (if not already patented) and licensed to industry at home or abroad. During the first five years the Board of Trade can make advances to the Corporation (the amount outstanding at any time not to exceed £5 millions) to defray capital expenditure, including initial expenses, and the provision of working capital. Furthermore, by way of overdraft or otherwise, the Corporation can borrow up to £250,000. In conclusion, it might be mentioned also that the term "invention" for this Act means any new process or new technique and applies whether a patent has been or could be granted.

Notes from the Branches

Newcastle-upon-Tyne

The Newcastle-upon-Tyne Branch of the Institute of British Foundrymen held their February meeting in the Neville Hall, with the President, Mr. S. Unsworth, in the chair. The lecturer on that evening was Mr. R. H. Smith, the senior vice-president, who gave a description of the re-building and equipment of a new foundry at the works of C. A. Parsons & Company, Limited, Newcastle-upon-Tyne. The progress of the work was illustrated with a most comprehensive series of slides. The new shops were erected on the site of an existing foundry and, while building was proceeding, the normal production of castings had to be maintained—no easy task. Particular points to which attention was drawn were the extensive use made of jib cranes running on the lower girders clear of the overhead cranes; these had proved of great help in speeding up the work. Another point was the installation of permanent fabricated box pits in the floor of the heavy foundry, where elaborate precautions were taken to prevent seepage of water.

As well as the large foundry, slides were shown of a fully-mechanised foundry for smaller castings. Here, hand ramming and heavy operations had to a large extent been eliminated by suitable tools and machines.

A striking example of foundry cleanliness was given on a slide showing the core-shop where there were employed large numbers of girls. Another illustration showed the use of wire mesh with sand underneath alongside a battery of furnaces, the idea being to reduce the danger of injury from sparks and splashes when pouring. Two further points stressed were the extensive ventilation arrangements and the installation of fluorescent lighting.

Answering questions, Mr. Smith said in their foundry they had not felt the curtailment of recruitment which had been experienced in other parts of the country.

Exhibitions for Training Purposes

Exhibitions in steel-producing areas throughout the country, arranged by the British Iron and Steel Federation, will be the central feature of an educational and training drive in the industry. Eight big industrial centres—Middlesbrough, Sheffield, Manchester, Scunthorpe, Glasgow, Bilston, Cardiff and Swansea—are to have the exhibitions. The first exhibition opens at Middlesbrough and will be followed by that at Sheffield early in April. Schools in every part of the country and educational experts are being invited to the exhibitions, each of which will last for approximately a week. In addition to viewing the exhibition, an opportunity for informal discussion will be afforded.

A central committee has prepared a training scheme for young workers up to the age of 21 years, and this will be operated by an organisation covering the whole country, which has been set up for that purpose. The scheme provides for all young people entering the industry. Its main purpose is to ensure introductory training to bridge the gap between school and industry, the provision of skilled instruction in each task which young people perform within the works and, as far as possible, the release for one day a week for vocational and non-vocational training by local education authorities. Interchange visits of students and technicians between this country and overseas steel-producing countries will be continued and increased. Educational films, film strips and instructional booklets are being produced as part of the campaign.

Mond Nickel Fellowships

The Mond Nickel Fellowships Committee invites applications for the award of Mond Nickel Fellowships for the year 1949. Awards will be made to selected applicants of British nationality educated to University degree or similar standard, though not necessarily qualified in metallurgy, who wish to undergo a programme of training in industrial establishments; they will normally take the form of travelling Fellowships; awards for training at universities may be made in special circumstances. There are no age limits, though awards will seldom be given to persons over 35 years of age. Each Fellowship will occupy one full working year. The Committee hope to award up to five Fellowships each year of an average value of £750 each.

Applicants will be required to state the programme of training in respect of which they are applying for an award, as well as particulars of their education, qualifications and previous career. Full particulars and forms of application can be obtained from the Secretary, Mond Nickel Fellowships Committee, 4, Grosvenor Gardens, London, S.W.1. Completed application forms will be required to reach the Secretary of the Committee not later than June 1, 1949.

THE ANNUAL CONFERENCE of the Institute of Vitreous Enamellers will this year be held in Birmingham from October 6 to 8, with the Annual Dinner on October 7.

The "Garrett" Report

"Supplement to Journal and Report, April, 1949—Recommendations of the Joint Advisory Committee on Conditions in Ironfoundries, with Notes and Relevant Quotations from the Factory Acts, 1937 and 1948," is the rather cumbersome title of a pamphlet issued by the Amalgamated Union of Foundry Workers to its members. The Union has certainly done an excellent piece of work in explaining to its members the implications of the "Garrett" Report, for without the co-operation of the employees, a veritable "Ritz" of a foundry can be converted to slum workshop very quickly, whilst on the other hand, by good house-keeping, a small old-fashioned concern can be made to resemble a cheerful country cottage. We are sincere believers in putting such plans on paper, as has been done in this booklet, for of the general picture there are invariably some features which can be usefully adopted by all ironfoundry concerns. Some idea of the progress achieved is indicated by a chosen series of photographs, and it may be that they will give rise to the conversion by operatives of further types of labour-saving, or in other respects more efficient plant. Some illness statistics are given in an accompanying letter from the secretary, and from it we note that influenza is rife, but this ailment seems to be equally prevalent in the publishing business. After all, bacteria are rather indiscriminate in their attachments. Of industrial diseases we think that rheumatism is the worst enemy of the moulder, and if we were called on to kneel in damp sand we think we would demand a small rubber mat! Yet probably the major cause is leaving work on a summer's day whilst wearing sweat-wetted clothes, and omitting to put on a "sweater"—a precaution always taken by the fast bowler after his six overs.

Properly studied by foundry employees, this book will do more good in the prevention of accidents than a whole series of illustrated posters, for, by focusing attention on potential dangers and their elimination, foundries will be much safer places in which to work. Despite all the Factory Acts on the Statute Book, the major cause of accidents is, and always will be, untidiness. Because the foundry is not really an industry but a collection of industries, it behoves intelligent readers of the pamphlet to be sufficiently realistic to correlate amenities with the size of the unit, for as we have pointed out elsewhere, actually they do not make for that production-efficiency which is the insistent call of the moment.

THE ENGINEERING AND MARINE EXHIBITION at Olympia, to be held from August 25 to September 10, will again incorporate the Welding Exhibition, which will occupy the annexe at the south end of the Grand Hall. Almost all manufacturers of welding equipment will be exhibiting there, but a feature of particular interest will be a stand 90 ft. long, occupied by resistance welding machine manufacturers.

News in Brief

THE COMBINED TIN COMMITTEE has made additional interim allocations of tin for the first half of 1949 totalling 345 tons.

MARFAC, LIMITED, iron and steel stockholders, of Liverpool, has opened a branch warehouse at 60A, Whitehall Road, Leeds.

CLARKE, CHAPMAN & COMPANY, LIMITED, manufacturing marine engineers, etc., of Gateshead, has orders in hand to the value of £9,000,000.

FOUR SMALL Petter petrol and Diesel engines will be shown by British Oil Engines (Export), Limited, the export division of Associated British Oil Engines, Limited, at the forthcoming International Trade Fair at Poznan.

AT AN INTERNATIONAL EXHIBITION to be held at Liége from April 30 to May 15, Stone-Wallwork, Limited, is showing certain foundry equipment on the stand of the Foundry Equipment Company, 195-199, Rue St. Leonard, Liége.

STONE-WALLWORK, LIMITED (a subsidiary of J. Stone & Company, Limited, Deptford, London, S.E.14), has appointed Fisher, Baxter & Company, 140, West George Street, Glasgow, C.2 (telephone: Douglas 1061), as its representatives in Scotland.

THE MELTING SHOP of the Skinningrove Iron Company, Limited, achieved a new weekly production record recently with an output of 5,768 tons of steel ingots. Of this, 2,671 tons were produced in "A" furnace, which also beat all previous records.

LANSING BAGNALL, LIMITED, manufacturers of petrol and electric trucks and tractors, has now removed its entire factory and offices from Isleworth, Middx, to Kingsclere Road, Basingstoke, Hants, where additional facilities are available for the manufacture of the company's products.

C. A. PARSONS & COMPANY, LIMITED, Newcastle-upon-Tyne, has completed a miniature turbo-generator of 50 kw. for use in a university at Sydney, Australia. It is the first of seven to be supplied free of cost by the firm to universities in Britain and the Empire to help the development of electrical engineering.

YARROW & COMPANY, LIMITED, shipbuilders and engineers, of Glasgow, has formed a new subsidiary registered in Johannesburg and Southern Rhodesia. This subsidiary, Yarrow (Africa) (Pty.), Limited, will receive orders on the company's behalf, and the Glasgow works will provide plans and materials. These will be shipped to South Africa and the subsidiary will undertake the construction work.

JUAN E. MARTINEZ O., Gorbea 2555, Casilla 451, Santiago, wishes to establish connections with United Kingdom manufacturers of Diesel engines, Diesel-driven generator sets, motor pumps, hand tools, etc. Interested companies should contact the firm direct, at the same time notifying the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1 (reference C.R.E. (I.B.) 6113/49), of any action taken.

SAMUEL OSBORN & COMPANY, LIMITED, steel and tool manufacturers, of Sheffield, which has a Canadian sales company, Samuel Osborn (Canada), Limited, with big warehouse space and an expert sales organisation of agents and representatives covering the whole of the Dominion, is to offer these sales facilities to non-competitive British firms anxious to develop exports in the Canadian market. Mr. Cyril Bark, president of the organisation in Canada, is coming to this country in May and will see representatives of British firms who are interested in the offer.

THE POWER-GAS CORPORATION, LIMITED, Stockton-on-Tees, which has already built four water-gas units for African Explosives & Chemical Industries (Pty.), Limited, at its nitrogenous fertiliser plant at Modderfontein, has booked an order to build three more units for the same concern. This contract, it is stated, brings the total number of Power-Gas installations of this type up to 118, with a combined capacity of 17,000,000 cub. ft. per hr. Plants built by the Stockton firm are already operating in Canada, China, Italy, Russia, Japan, India, Australia, and Holland.

MR. F. MASSY BURNSIDE, managing director of Horrocks, Roxburgh Pty., Limited, 517-519, Little Collins Street, Melbourne, who expects to visit the United Kingdom from the end of April till October, wishes to contact United Kingdom manufacturers of locomotives, mechanical shovels, trench-digging machines, road-making plant, etc., with a view to their representation in Australia. Interested companies should notify the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1 (reference, C.R.E.(I.B.) 4970/49).

THE NEW 109-LB. FLAT-BOTTOM RAILS adopted by British Railways as standard for main lines and others carrying intensive traffic at high speed were rolled on March 21 for the first time in this country at the Cleveland Works, Middlesbrough, of Dorman, Long & Company, Limited. The new rail will replace eventually the present standard 95-lb. bull-head rail on 22,000 miles of track. On secondary lines the track consists at present of 85-lb. bull-head section rails, and these will be superseded by 98-lb. flat-bottom rails. Dorman, Long, & Company, will also begin rolling the new 98-lb. flat-bottom rail in the near future.

A NEW FOUNDRY, stated to be unique in its class in this country, is nearing completion at the Walkergate Works, Newcastle-upon-Tyne, of C. A. Parsons & Company, Limited. At the firm's Heaton Works a new core-plate shop has started production and the old shop has been closed. The mirror shop has still to move into new premises and the copper-coil forming section is to be transferred into new quarters. Additional women's machines are being installed in the transformer coil winding shop so that it will not be necessary any longer for women to work a night-shift. These new machines, it is stated, are costing the company about £1,000 for every woman employed on this work.

MR. ARCHIBALD ALLAN, who died suddenly in an Edinburgh hospital on March 16, was the sole partner in the firm of John White & Company, brassfounders, of Edinburgh.

Pig-iron and Steel Production in Great Britain

Detailed Figures for January

The following particulars of pig-iron and steel production in Great Britain have been extracted from the Statistical Bulletin for February, 1949, issued by the British Iron and Steel Federation. Table I gives the production of pig-iron and ferro-alloys in January, with the number of furnaces in blast; Table II, production of steel ingots and castings in January, and Table III, deliveries of finished steel. Table IV summarises steel-industry activities during six months ended January, 1949.

TABLE I.—*Weekly Average Production of Pig-iron and Blast-furnace Ferro-alloys, January,* 1949. (*Thousands of Tons.*)

District.	Furnaces in 29.1.49	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants, and Essex	26	—	13.9	24.3	2.0	—	40.2
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Ches. ..	6	—	6.6	—	—	1.4	8.0
Yorkshire (incl. Sheffield, excl. N.E. Coast) ..							
Lincolnshire ..	15	—	24.4	—	—	—	24.4
North-East Coast	24	7.9	35.4	0.6	—	1.5	45.5
Scotland	8	0.7	9.5	3.1	—	—	13.3
Staffs., Shrops., Worcs., and Warwick ..	9	—	8.8	1.4	—	—	10.2
S. Wales and Monmouthshire	8	3.8	18.3	—	—	—	22.1
North-West Coast	7	13.6	—	0.2	—	0.6	14.4
Total ..	103	26.0	116.9	29.6	2.0	3.5	178.1
December, 1948*	102	24.9	117.2	28.9	1.8	3.1	176.0
January, 1948* ..	102	24.2	112.6	27.1	1.2	2.7	167.8

*Total for January includes 100 tons of direct castings.

TABLE III.—*Weekly Average Deliveries of Non-alloy and Alloy Finished Steel.* (*Thousands of Tons.*)

Product.	1947 (53 weeks).	1948.	1948. Jan.	1948. Dec.*	1949. Jan.
Non-alloy Steel :—					
Heavy rails and sleepers	7.6	8.9	9.1	8.4	9.9
Heavy and medium plates	31.6	36.2	34.0	38.5	35.7
Other heavy products	31.8	34.7	35.0	34.5	33.6
Light rolled products (excl. wire rods and alloy-steel bars) ..	49.7	55.4	53.3	53.1	61.9
Ferro-concrete bars	3.2	4.1	3.0	4.7	
Cold-rolled strip ..	4.6	4.7	4.8	4.7	5.1
Bright steel bars ..	4.8	6.0	6.6	6.0	6.5
Sheets, coated and uncoated	24.3	26.3	27.1	26.9	29.3
Tin, terne and blackplate	12.1	13.5	14.0	13.6	14.6
Tubes, pipes and fittings	13.5	15.1	14.5	15.9	17.1
Wire	10.8	12.8	11.8	13.7	14.5
Tyres, wheels and axles	3.5	3.9	3.1	4.0	4.0
Forgings	5.0	6.0	5.2	6.0	6.3
Castings	3.0	3.5	3.1	3.6	3.7
Total	205.5	231.1	224.6	233.6	242.2
Alloy Steel† *:—*					
Plates	—	—	—	—	—
Tubes and pipes ..	0.3	0.4	0.5	0.4	0.5
Bars, sheets, strip and wire	3.7	4.7	4.3	5.4	5.0
Forgings	1.8	2.5	2.0	2.8	3.0
Castings	0.6	0.7	0.6	0.8	0.8
Total	6.4	8.3	7.4	9.4	9.3
Total U.K. production‡	211.9	239.4	232.0	243.0	251.5
Less Intra-industry conversion ..	19.2	29.0	24.9	32.5	32.7
Total U.K. deliveries	192.7	210.4	207.1	210.5	218.8
Add deliveries of imported finished steel	2.2	3.4	1.5	5.6	5.6
Total deliveries of finished steel ..	194.9	213.8	208.6	216.1	224.4

† Excludes high-speed steel.
‡ Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.

TABLE II.—*Weekly Average Production of Steel Ingots and Castings, January,* 1949. (*Thousands of Tons.*)

District.	Open-hearth. Acid.	Open-hearth. Basic.	Bessemer.	Electric.	All other.	Total. Ingots.	Total. Castings.	Total ingots and castings.
Derby, Leics., Notts., Northants and Essex ..	—	—	10.6(Basic)	1.4	0.2	11.6	0.6	12.2
Lancs. (excl. N.W. Coast), Denbigh, Flints., and Ches.	1.5	22.7	—	1.1	0.5	24.8	1.0	25.8
Yorkshire (excl. N.E. Coast and Sheffield)								
Lincolnshire	—	28.9	—	—	0.1	28.9	0.1	29.0
North-East Coast	1.8	57.9	—	0.7	0.4	59.4	1.4	60.8
Scotland	3.5	26.7	—	1.7	0.6	31.3	1.2	32.5
Staffs., Shrops., Worcs. and Warwick	—	14.9	—	0.6	0.8	15.0	1.3	16.3
South Wales and Monmouthshire ..	12.0	43.7	5.1 (Basic)	0.8	0.1	61.4	0.3	61.7
Sheffield (incl. small tonnage in Manchester) ..	8.4	25.8	—	8.1	0.6	41.0	1.9	42.9
North-West Coast	0.6	2.4	3.9 (Acid)	0.3	0.1	7.1	0.2	7.3
Total	27.0	222.8	19.6	11.1	—	280.5	—	—
December, 1948*	26.2	219.4	19.6	13.7	3.4	274.4	7.9	282.3
January, 1948	25.9	219.0	19.2	13.0	3.5	272.7	7.9	280.6

* Five weeks.

(*Continued at foot of facing page.*)

Outlook for N.-E. Shipyards

"A Little Doubtful After 1951"

At a Press conference at Newcastle-upon-Tyne, Sir Mark Hodgson, chairman of the North Regional Board for Industry, said that although North-East shipyards were booked up until 1951, the position after that date appeared to be a little doubtful. The number of men employed in shiprepairing in the area was 2,000 fewer than in December, 1947, but there had been an increase in the number employed on new construction. On the question of foreign competition, Sir Mark admitted that the firm which could quote a lower figure would always be a menace, but there was no immediate danger from this. Sir Mark said the engineering industry was a complicated trade and he could not give an opinion immediately on the possibility of a recession in this industry.

The labour force in the shipbuilding and shiprepairing industries in 1938 was 38,000, compared with 58,000 in the peak period of the war and 43,000 last December. In 1948, man-power working on new production on the Tyne was 13,400, compared with 12,000 the previous year; the Wear figure was 8,400, compared with 8,300, and the Tees 6,400, against 5,800. The total for the three areas was 28,200, against 26,200. There were 15,100 employed in shiprepairing, against 17,200 the year before. There was no immediate anxiety regarding possible unemployment in the shiprepairing industry.

MR. R. W. BAILEY, head of the mechanical and metallurgical research department of the Metropolitan-Vickers Electrical Company, Limited, Manchester, was one of 25 new Fellows elected at a recent meeting of the Royal Society. Others included:—MR. U. R. EVANS, Reader in Metallic Corrosion, Cambridge; SIR BEN LOCKSPEISER, Chief Scientist, Ministry of Supply; MR. J. M. MCNEILL, naval architect, John Brown & Company, Limited, Clydebank; and MR. N. W. PIRIE, head of the biochemical department, Rothamsted Experimental Station, Harpenden.

Eire Foundry Workers' Claim

When the Irish Engineering and Foundry Union claimed increased wages for its member workers of Allied Ironfounders (Ireland), Limited, Waterford, at the Eire Labour Court, Counsel for the Federated Union of Employers described the position. The Waterford Foundry, he said, was struggling to survive its infantile troubles and should have encouragement from the workers. Profits made so far were not enough to pay the ordinary share dividends. The offer already made to the workers was more than last year's entire profits and represented an additional £3,000 to be made. Now the increase claimed would cost the company over £9,000 a year and "one could not help speculating if the workers' desire was to sink the company altogether."

The secretary of the applicants' Union said that far from such suicidal desires and rather than face unemployment they would accept the present position hoping that the industry would be worked on a fair basis for all.

The Court's findings were deferred.

Recent Shipbuilding Orders

The following are among shipbuilding orders recently announced:—

VICKERS-ARMSTRONGS, LIMITED, Newcastle-upon-Tyne, four passenger motorships for Ellerman Lines, Limited.

SMITH'S DOCK COMPANY, LIMITED, North Shields, two 14,500-ton tankers for H. E. Moss & Company, Liverpool.

BLYTH DRY DOCKS & SHIPBUILDING COMPANY, LIMITED, two oil tankers of 12,600 tons for Mr. A. P. Moller, of Denmark.

JOHN BROWN & COMPANY, LIMITED, Clydebank, a cargo vessel for the Peninsular & Oriental Steam Navigation Company, London.

BLYTH DRY DOCKS & SHIPBUILDING COMPANY, LIMITED, a cargo and passenger steamer for Gdynia-America Shipping Lines, Limited, Gdynia.

PIG-IRON AND STEEL PRODUCTION IN GREAT BRITAIN (*Continued from previous page*).

TABLE IV.—*General Summary of Pig-iron and Steel Production.* (*Weekly Average in Thousands of Tons.*)

Period.	Iron-ore output.	Imported ore consumed.	Coke receipts by blast-furnace owners.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy).			
						Imports.‡	Output of ingots and castings.	Deliveries of finished steel.	Stocks.†
1938	228	89	—	130	118	16	200	—	—
1947 (53 weeks)	209	136	165	147	145	8	240	195	797
1948	252	172	200	178	174	8	286	214	1,028
1948—August	233	171	200	174	162	6	271	182	986
September* ..	273	175	202	181	183	10	297	225	1,002
October	270	175	202	183	184	13	297	223	1,004
November	264	174	205	185	187	13	303	229	1,002
December*	253	162	201	176	173	10	282	216	1,028
1949—January	269	163	202	178	178	8	289	224	1,018

* Five weeks. † Stocks at th end of the years and months shown. ‡ Weekly average of calendar month.

Personal

SIR EDWARD APPLETON has been awarded the James Alfred Ewing Medal of the Institution of Civil Engineers.

MR. H. S. HASLAM has resigned from the board of English Clays Lovering Pochin & Company, Limited, St. Austell, Cornwall.

MR. BENJAMIN MOWER, assistant manager of the test house at the Cleveland Works of Dorman, Long & Company, Limited, has retired after 52 years' service with the company.

MR. R. P. MIDDLETON has been appointed manager of Barr's (Sheffield), Limited, electrical engineers and contractors, of Sheffield. He is a director of the company, which is associated with Electric House (Denton), Limited.

MR. J. LENAGHAN, manager and technical director of William Gray & Company, Limited, West Hartlepool, has been elected chairman of the Tees-side section of the North East Coast Institution of Engineers and Shipbuilders.

MR. JACK WILLIAMS, assistant area manager of the General Electric Company, Limited, at Cardiff, has been appointed area manager at Newcastle-upon-Tyne of the company's North-Eastern area. He joined the company in 1910.

MR. T. A. HILL, manager of the boiler department of George Clark (1938), Limited, Sunderland, has received presentations on the occasion of his departure to become production manager of a Midlands engineering firm.

MAJOR C. B. THORNE, the director and general secretary of the Institution of Production Engineers, has tendered his resignation on being adopted prospective Conservative candidate for Uxbridge. He joined the Institution in March, 1945.

MR. H. L. SATCHELL, manager of the Rugby Works of the British Thomson-Houston Company, Limited, and its associated factories at Peterborough, Leicester (Blackbird Road) and Nelson (Lancs), has been appointed a director of the company.

MR. F. STANLEY MOCKFORD, commercial manager of Marconi's Wireless Telegraph Company, Limited, has been elected chairman of the Radio Communication and Electronic Engineering Association. MR. V. M. ROBERTS, of the British Thomson-Houston Company, Limited, is the new vice-chairman.

MR. WILLIAM M. SHANKS, a director of Cruikshank & Company, Limited, foundrymen, of Denny, received a presentation of a silver salver, suitably inscribed, to mark the occasion of his recent marriage. The presentation was made by Mr. John Dyer, the firm's oldest employee with 67 years' service, on behalf of employees.

MR. JAMES M. MORTON, who for the past 10 years has been general manager of the Penarth Pontoon, Slipway & Ship Repairing Company, Limited, and its associate firms at Barry and Cardiff, has been appointed managing director of the companies. He was chairman of the Bristol Channel Ship Repair Association during the years 1947 and 1948.

MR. S. J. LEWIS, formerly sales manager of the British Motor Boat Manufacturing Company, Limited, has been appointed assistant export manager of the Brockhouse organisation, and will take charge of the export department in the Brockhouse London office, which, as from Monday, will be at 25, Hanover Square, W.1 (telephone: Mayfair 8783). The British Motor Boat Manufacturing Company, Limited, was recently absorbed into its parent company, Brockhouse Engineering (Southport), Limited.

DR. L. F. BATES, Lancashire-Spencer Professor of Physics at Nottingham University, has been awarded the Holweck Prize and Medal by the Société Française de Physique. The Holweck Prize was founded by the Physical Society as a memorial to Fernand Holweck, director of the Curie Laboratory of the Radium Institute in Paris, and to other French physicists who were killed by the Germans during the occupation. The Société Française de Physique founded the Holweck Medal in bronze for presentation to the prizewinner. The award is made annually, alternately to a French and to a British physicist, for distinguished work in experimental physics.

Changes of Name

The following companies have recently changed their names, the new titles being given in parentheses:—

H. C. ALLIN, LIMITED, metal workers, etc., of Doncaster (Doncaster Electro-Platers, Limited).

BYRON WHOLESALE SUPPLIERS, LIMITED, London, W.C.2 (Faima Engineering Company, Limited).

DAVIS BROS. ILLUMINATING ENGINEERS, LIMITED, London, N.1 (Davis Sheet Metal Engineering Company, Limited).

MEXICAN OVERSEAS TRADING, LIMITED, metals, machinery, tools, etc., of London; E.C.2 (L. H. Brokers, Limited).

TOLEDO PRODUCTS, LIMITED (formerly Toledo Wrought Iron (Furniture), Limited), London, W.C.2 (Afia (London), Limited).

COMMERCIAL STRUCTURES, LIMITED, structural engineers, machinery merchants, etc., of London, E.10 (Chamberlain Industries, Limited).

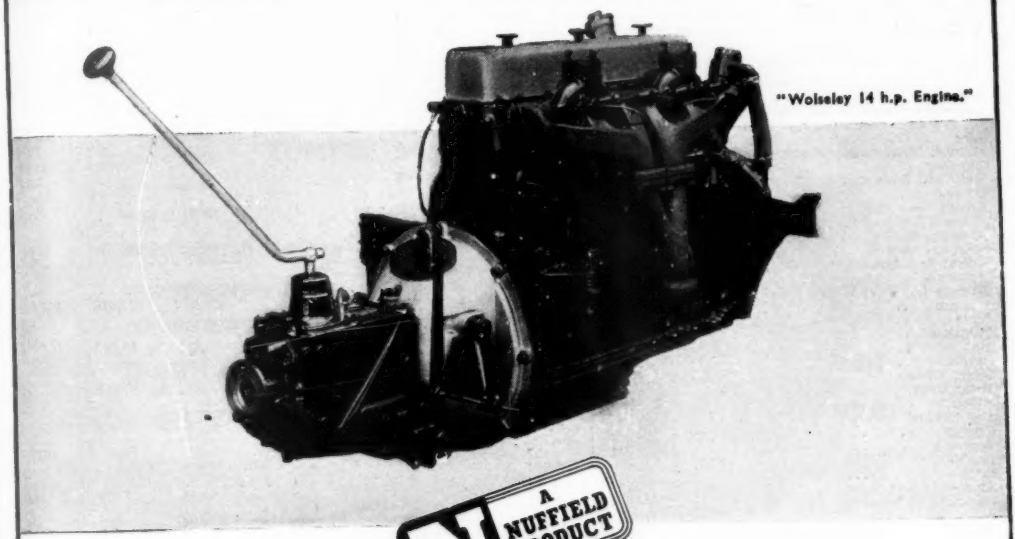
ROBERT R. PATON, LIMITED (formerly Robert Paton (Incorporating Frank Munns), Limited), iron, steel, plant and machinery merchants, etc., of London, N.W.10 (Cardiff Lathe & Tool Works, Limited).

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference E.P.D. or C.R.E. can be obtained from the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1.

HARTISMERE, April 26—Provision and laying of approx. 3 miles of 6-in., 9 miles of 5-in., 15 miles of 4-in. and 6 miles of 3-in. dia. spun-iron water mains, etc. (Stage III); and provision and laying of approx. 5 miles of 6-in., 6 miles of 4-in. and 1 mile of 3-in. dia. spun-iron water mains, etc. (Stage IV), for the Rural District Council. W. Herbert Bateman & Partners, consulting engineers, 167, Victoria Street, Westminster, London, S.W.1. (Fee £5 5s., returnable.)

SUSSEX, April 20—Contract No. 1:—Providing and laying approx. 16 miles of 9-in. dia. spun-iron flexible pipes, etc., for the North-West Sussex Joint Water Board. Edward Sandeman, Kennard & Partners, consulting engineers, 1, Victoria Street, Westminster, London, S.W.1. (Fee £3 3s., returnable.)


"Wolseley 14 h.p. Engine."

N A NUFFIELD PRODUCT

Using

STANTON-DALE

REFINED PIG IRON

USED AND RECOMMENDED
FOR ALL HIGH-DUTY
ENGINEERING CASTINGS

THE STANTON IRONWORKS COMPANY LIMITED, Nr. NOTTINGHAM

Imports and Exports of Iron and Steel

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in February. Figures for the same month in 1947 and 1948 are given for purposes of comparison.

Total Exports of Iron and Steel

Destination.	Month ended February 28/29/28.		
	1947.	1948.	1949.
	Tons.	Tons.	Tons.
Eire	5,606	4,885	5,719
Channel Islands	230	574	1,007
Gibraltar	45	428	310
Malta and Gozo	130	294	739
Cyprus	236	248	410
British West Africa	3,796	3,640	7,354
Union of South Africa	11,833	12,263	9,160
Northern Rhodesia	402	65	1,547
Southern Rhodesia	1,829	784	4,800
British East Africa	1,857	3,236	5,833
Mauritius	2	430	164
Bahrein, Loweit, Qatar and Trucial Oman	3,485	1,336	1,546
India	6,083*	3,794	4,688
Pakistan		309	2,482
Malaya	2,552	1,399	4,210
Ceylon	451	667	1,729
North Borneo	304	674	1,513
Hong Kong	1,101	1,336	3,060
Australia	2,500	3,671	9,388
New Zealand	3,111	4,956	6,985
Canada	341	434	1,700
Bermuda	4	41	67
British West Indies	2,085	960	3,603
British Guiana	21	10	346
Anglo-Egyptian Sudan	713	445	969
Other British countries	164	237	2,597
Russia	45	294	3,006
Finland	3,104	8,948	4,546
Sweden	5,118	9,358	4,321
Norway	2,918	3,188	5,709
Iceland	452	277	222
Denmark	4,661	4,565	8,816
Poland	18	37	301
Germany	112	108	48
Netherlands	7,419	6,739	10,969
Belgium	3,230	1,519	1,019
France	1,447	512	3,632
Switzerland	1,023	1,734	1,571
Portugal	897	2,847	1,734
Spain	330	342	1,892
Italy	15	265	241
Hungary	—	—	15
Czechoslovakia	12	70	31
Greece	1,298	316	793
Turkey	1,104	1,112	2,409
Dutch East Indies	537	1,270	2,314
Dutch West India Islands	1,176	496	380
Belgian Congo	179	31	223
French W. and Eq. Africa	17	11	204
Portuguese East Africa	378	459	281
Canary Islands	123	377	244
Syria	479	39	120
Lebanon	335	292	4,131
Palestine (Israel)	5,612	2,149	1,754
Egypt	3,396	4,592	3,658
Morocco	82	78	16
Iraq	4,574	1,594	1,308
Iran	3,932	6,723	9,883
Burma	3,529	2,628	857
Siam (Thailand)	1	149	421
China	3,334	3,140	657
U.S.A.	2,856	125	230
Cuba	42	19	26
Colombia	466	973	425
Venezuela	2,301	4,729	4,791
Ecuador	227	—	567
Peru	524	6	1,277
Chile	439	17	181
Brazil	3,122	2,122	1,656
Uruguay	246	785	1,288
Argentine Republic	4,907	3,459	5,990
Other foreign countries	7,019	2,499	2,044
Total	131,917	128,109	178,127

* Figures for 1947 relate to British India.

Total Imports of Iron and Steel

From	Month ended February 28/29/28.		
	1947.	1948.	1949.
	Tons.	Tons.	Tons.
Australia	4,473	1,771	2
Canada	19,981	4,079	6,086
Other British countries	582	145	112
Sweden	745	1,217	1,518
Norway	1,963	2,309	2,513
Germany	21	17	471
Netherlands	2,010	145	5,875
Belgium	1,984	4,815	28,470
Luxemburg	765	651	7,076
France	47	59	13,416
U.S.A.	14,431	11,063	9,104
Other foreign countries	10	458	764
Total	47,012	26,729	73,407
Iron ore and concentrates—			
Manganiferous	8,970	—	—
Other sorts	392,588	587,048	492,526
Iron and steel scrap and waste, fit only for the recovery of metal	16,271	46,085	107,626

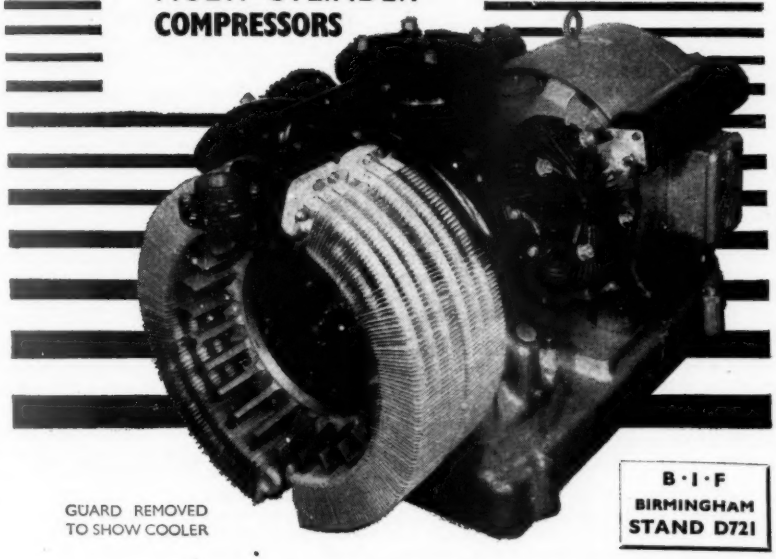
Exports of Iron and Steel by Product

Product.	Month ended February 28/29/28.		
	1947.	1948.	1949.
	Tons.	Tons.	Tons.
Pig-iron	6,074	29	294
Ferro-alloys, etc.—			
Ferro-tungsten	25	132	5
Spiegeleisen, ferro-manganese	1,966	1,208	519
All other descriptions	30	55	87
Ingots, blooms, billets and slabs	124	125	60
Iron bars and rods	345	318	827
Sheet and tinplate bars, wire rods	367	198	118
Bright-steel bars	1,952	2,420	1,699
Other steel bars and rods	11,668	8,841	10,645
Special steel	1,154	1,681	1,161
Angles, shapes and sections	6,686	7,901	7,557
Castings and forgings	294	521	618
Girders, beams, joists and pillars	2,374	1,554	1,530
Hoop and strip	1,957	2,896	3,855
Plate, ¼ in. thick and over	9,392	8,718	17,528
Plate under ¼ in. thick	3,618	6,231	10,717
Galvanised sheets	2,577	4,668	6,307
Tinplates	7,485	12,021	16,992
Tinned sheets	209	369	309
Terne plates	38	29	—
Decorated tinplates	546	97	97
Other coated plates	207	276	219
Cast-iron pipes, up to 6-in. dia.	4,655	3,486	6,814
Do., over 6-in. dia.	3,003	2,411	3,454
Wrought-iron tubes	20,754	22,037	22,432
Radiators and central-heating boilers	281	323	294
Railway material	11,756	8,461	15,514
Wire	3,703	2,250	3,790
Cable and rope	1,986	1,732	2,003
Netting, fencing and mesh	1,277	1,427	2,012
Other wire manufactures	524	628	1,108
Nails, tacks, studs, etc.	760	558	764
Rivets and washers	640	659	929
Wood screws	414	399	258
Bolts, nuts and metal screws	1,519	1,359	1,752
Stoves, grates, etc. (excl. gas)	382	793	770
Do., gas	93	243	230
Sanitary cisterns	50	87	197
Baths, sinks, etc.	102	442	868
Fencing material	125	137	219
Anchors, etc.	683	540	718
Chains, etc.	643	685	692
Springs	350	483	483
Hollow-ware	5,058	4,396	7,212
All other manufactures*	14,040	14,036	19,164
Total	131,917	128,109	178,127

* Figures for 1949 are not completely comparable with those for previous years.

BULLOWS

MULTI-CYLINDER
COMPRESSORS



GUARD REMOVED
TO SHOW COOLER

B·I·F
BIRMINGHAM
STAND D721

DESIGNED FOR FOUNDRY NEEDS

IMPERVIOUS TO DUST.—Sealed crankcase and efficient air filters.

DELIVER COOL DRY AIR.—Efficient inter- and after-coolers cool air BEFORE entering air receiver.

PROVED RELIABILITY.—Simple construction, generous working parts. Bullows Patent Valve Gear.

★ *LIGHT · COMPACT · SILENT · FREE FROM VIBRATION*

Available in sizes up to 108 C.F.M. · displacement—one, two or three stages.

Working pressures from 25—350 lb./sq. in.

We shall be pleased to send full particulars or arrange for a representative to call.

WE ALSO MAKE A COMPLETE RANGE OF SPRAY PAINTING EQUIPMENT

ALFRED BULLOWS & SONS LTD · LONG ST · WALSALL · STAFFS · TEL: 2261

DEPOTS AT—13 SOUTH MOLTON ST., LONDON, W.1 · TEL.: MAYFAIR 2313
8 ATHOLE GARDENS, GLASGOW, W.2 · TEL.: KELVIN 2726
55A BRIDGE STREET, MANCHESTER, 3 · TEL.: BLACKFRIARS 5670
BULLOWS HOUSE, 9 BURGH QUAY, DUBLIN, EIRE · TEL.: DUB. 21852

Raw Material Markets

Iron and Steel

Although deliveries of foundry coke are being maintained at allocated levels, some complaints are being received about quality. No difficulty is experienced in obtaining the required tonnages of ganister and limestone. Ferro-alloys are also obtained freely, and supplies of firebricks are more adequate.

Current pig-iron deliveries, however, are barely sufficient. This applies particularly to high-phosphorus pig-iron for the light foundries, although the pressure for castings is not so heavy as it was some months ago, when supplies of this grade of pig-iron fell far short of requirements. A similar position obtains in regard to pig-iron for the engineering, jobbing and speciality foundries, although these users can utilise the low- and medium-phosphorus grades and hematite and also the refined grade of pig-iron. All the furnaces have sufficient commitments to absorb production, and there is no "free" iron apart from refined.

The activity of the sheet and re-rolling mills continues to be very largely governed by the extent of the deliveries of material. There is no lack of orders at these establishments, but the avidity with which works buyers are seeking defective material and re-rolling scrap is eloquent evidence of the deficiencies in the supply of primes. Producers of sheet bars and small billets cannot fully satisfy the demand and increased imports from France and Belgium are eagerly sought. Fortunately, the heavier classes such as slabs and blooms are being produced in satisfactory tonnages, and re-rollers are helping to swell the aggregate output of thin plates.

Plate mills are neither seeking, nor are they in a position to accept, further business at present, unless it be of the highest priority. Their commitments for Period II are already very heavy, and it is significant that the 1949 target for completed tonnage in the shipyards is about 120,000 tons below the figure for 1948. On the other hand, more steel will be allocated this year for capital re-equipment and a slight increase in the export quotas has been authorised. There is a widespread demand for sections, especially the lighter sizes, and rail mills have impressive rolling programmes. Locomotive builders have big export programmes and wagon builders are assured of full employment for the remainder of the year.

Non-ferrous Metals

It was anticipated that the fall in the price of lead would be followed by a decline in zinc, for these two metals have always shown a tendency to move in harmony with each other. What was not expected, however, was that the downward adjustment in zinc (1½ cents per lb.) would follow so quickly. At any rate, that was the view held in America, although sentiment in Britain has of late shown signs of increasing scepticism over American prospects for trade. Only a few weeks ago the prospects for lead appeared to be bright, for all reports showed a continuing world shortage and an even higher price. Then consumers ceased paying premiums for foreign lead and even began to show reserve on the domestic market. Much the same sort of thing has happened in zinc, in which, however, the post-war price appreciation has been less than in lead. In regard to both of these metals, however, it can be said that demand has recently fallen away, the culminating point being when it was realised that, temporarily at least, buying for the stockpile had ceased. This is the test which has been awaited, and it now appears that stockpiling is a real aid to the maintenance of the price level, but its continuity cannot be guaranteed. Perhaps copper has only been saved from a similar fate because the prolonged strike at the Utah mine robbed the market of between 70,000 and 80,000 tons.

For the present, the downward trend in scrap values on the United Kingdom market seems to have halted, possibly because a point has been reached when holders feel that they might as well continue to keep the metal in stock as part with it at such cut prices. In point of fact, there is not a great deal of scrap about at present, apart from the tonnage put out on tender by the disposals section of the Ministry of Supply. This includes a proportion of semis, and it is of some interest to note that export of this metal is prohibited, whether by the first purchaser or by any subsequent holder. The ban on the export of scrap, etc., is doubtless well conceived in the national interest, but its effect is, of course, to depress values.

Obituary

SIR HAROLD SNAGGE, chairman of D. Napier & Son, Limited, aero-engine manufacturers, from 1933 to 1943, and a director of many other companies, died at his home in London on March 19. He was 76.

MR. J. S. TAYLOR, buyer for Pott, Cassels & Williamson, manufacturers of chemical plant, foundrymen, etc., of Motherwell, where he had been employed ever since the works began 35 years ago, died recently.

PROF. CECIL HOWARD LANDER died suddenly at Shrivenham, where he occupied the post of Dean of the Military College of Science, on March 17. He was also Emeritus Professor of Engineering in the Imperial College and the University of London. Prof. Lander gained practical engineering experience with the Manchester Ship Canal Company and other Manchester firms. In 1906 he was appointed demonstrator and in 1910 lecturer in engineering at Manchester University. He held this position until 1916 when he was awarded his D.Sc. for investigations on heat flow, surface friction, and allied phenomena. He acted during these years as consulting engineer, and had charge of experimental work carried on for the Home Office on heating and ventilation, which later formed the basis of Factory Act regulations. In 1920 he became assistant to the Director of Fuel Research, and two years later succeeded Sir George Beilby as Director. From 1931 until 1946 Prof. Lander was London University Professor of Engineering at Imperial College.